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## Address of the President (Mr. Frank A. Leach, Jr.,) of the Pacific Coast Gas Association, Delivered on the Occasion of the Nineteenth Meeting, Oakland, Cal., September 20-23, 1911.

To the Members, Pacific Coast Gas Association: As President of the Pacific Coast Gas Association, and as a citizen of Oakland, I am very pleased to welcome you here this morning in our 19th annual convention.

The year just finished has been one of great activity and importance to the gas and allied industries on the Pacific Coast. There has been an ever-increasing demand for our commodity. New avenues for output have been opened and established sources of income enlarged.

The field for industrial appliances continues to increase, and it is now the exception to find a factory, laundry or workshop that is not using gas in some part of its operation.

There has been an increasing demand for gas for illumination, notwithstanding the great improvement in electric incandescent lamps during the past year. The introduction of high efficiency electric lamps, with their long, white rays, has popularized the brilliant white light of the gas arc and other mantle burners. The manufacturers of gas arcs have kept pace with the improvements of electric manufacturers, and there is to-day a strong demand for this form of illumination.

Light is popularly judged by comparison. Artificial light is compared with sunlight; one artificial illumination with another. And, gentlemen, from my observation of present day gas illumination, we, as gas men, have no apologies to make; nothing to fear; simply to send out our solicitors and the business is ours.

There has been introduced a new inverted, double-burner for street illumination, which is being installed in this city with great satisfaction. Already approximately 500 have been installed, and 200 more have been ordered. They are being placed in the thickly settled residence districts, where the sidewalks are lined with shade trees, and where the old form of street lighting by electric arcs 300 feet apart was practically useless. Thus not only are new avenues of revenue opening to us, but also are we again coming into our own.

The extensive development of the oil fields has continued. New gushers have been brought in, with many supplying enormous quantities of gas at great pressure. This gas has been conserved in a very limited way to date. Only a few small towns in the immediate vicinity are supplied, although a considerable quantity is being used under boilers in the fields. Reports have come from time-to-time that the gas wells are already showing signs of giving out; but experienced gas men from Eastern fields say they look for large development in this branch of their industry in the near future. The development of many individual producers of varying quality of oil has caused much concern to the gas companies buying from distributing companies. The difference in gravity and impurities is sufficient to cause great inconvenience in manufacture.

The advance in manufacture has been confined mainly to refinement in our well-established systems of oil gas which have come into general use in California. The use of residual carbon in the manufacture of carbureted water gas has been demonstrated a success, and it is now possible to regulate the production of carbon within the limits of its use for that purpose.

Under Senate constitutional amendment, No. I., adopted October 5, 1910, becoming effective January 1, 1911, and approved by the citizens of California under the Act of the Legislature (Chap. 335, approved April 1, 1911), the entire system of taxation for State purposes has been changed.

Section I sets forth: "Taxes levied, assessed and collected, as hereinafter provided, upon railroads, including street railways, whether operated in one or more counties; sleeping car, dining car, drawing room car and palace car companies, refrigerator, oil, stock, fruit, and other car-loaning and other car companies operating upon railroads in this State; companies doing express business on any railroad, steamboat, vessel, or stage line in this State; telegraph companies, telephone companies; companies engaged in the transmission or sale of gas or electricity; insurance companies; banks, banking associations, savings and loan societies, and trust companies; and taxes upon all franchises of every kind and nature, shall be entirely and exclusively for State purposes, and shall be assessed and levied by the State Board of Equalization, and collected in the manner hereinafter provided. The word 'company' and the word 'companies' as used in this act shall include persons, partnerships, joint stock associations, companies and corporations.

Section 2: "All railroad companies, including street railways, whether operated in one or more counties; all sleeping car, dining car, drawing room car and palace car companis, all refrigerator, oil,

stock, fruit and other car-loaning, and other car companies, operating upon the railroads in this State; all companies doing express business on any railroad, steamboat, vessel, or stage line in this State; all telegraph and telephone companies; and all companies engaged in the transmission or sale of gas or electricity shall annually pay to the State a tax upon their franchises, roadways, roadbeds, rails, rolling stock, poles, wires, pipes, canals, conduits, rights-of-way, and other property, or any part thereof, used exclusively in the operation of their business in this State, computed as follows: Said tax shall be equal to the percentages hereinafter fixed upon the gross receipts from operation of such companies and each thereof within this State. When such companies are operating partly within and partly without this State, the gross receipts within this State shall be deemed to be all receipts on business beginning and ending within this State, and a proportion, based upon the proportion of the mileage within this State to the entire mileage over which such business is done, of receipts on all business passing through, into, or out of this State."

"The percentages above mentioned shall be as follows: On all railroad companies, including street railways, 4 per cent.; on all sleeping car, dining car, drawing room car, palace car companies, refrigerator, oil, stock, fruit and other car-loaning, and other car companies, 3 per cent.; on all companies doing express business on any railroad, steamboat, vessel or stage line, 2 per cent.; on all telegraph and telephone companies, 3½ per cent.; on all companies engaged in the transmission or sale of gas or electricity, 4 per cent. Such taxes shall be in lieu of all other taxes and licenses, State, county and municipal, upon the property above enumerated of such companies, except as otherwise provided in section 14 of article 13 of the Constitution of this State, and as provided in section 22 of article 4 of said Constitution.

"The word 'municipal,' as used in this act, shall apply to incorporated towns and cities formed under article 11 of the Constitution of this State and to none other."

The preparation of reports required by the State Board of Equalization entailed a great burden upon the companies coming within the law and the 4 per cent. of gross receipts assessed to gas and electric companies has added materially to the total taxes paid. The total receipts of these companies in California, for the year ending December 31, 1910, was $30,458,313, producing over $1,200,000, or over 10 per cent. of the total amount of taxes raised for State purposes.

On September 1, 1911, Senate Bill, No. 14, passed by the Legislature, went into effect, relating to the liability of employers for injuries or death sustained by their employees, providing for compensation for the accidental injury of employees, established an Industrial Accident Board, to be appointed by the Governor, making an appropriation therefor, defining its powers and providing for a review of its awards

The terms of this Act are yet optional so far as assuming the fixed bases of compensation is concerned. The act fixes the amount to be paid in all cases from slight injuries to death. [But nothing is allowed if the period of disability does not last more than a week.] All disputes between injured workmen and their employers are to be adjusted by an Industrial Accident Board to be appointed by the Governor. Appeals lie to the Superior Court and then to the Supreme Court, but only as to the question of fraud and to the sufficiency of the facts to support the findings of the Board. All such appeals are to be given preference on the Court Calendar, but, whether accepted or not, the old defenses of contributory negligence, assumed risk and negligence of fellow servants, are repealed. In other words, if an employer chooses to place himself within the act, his responsibility and damage are clearly determined thereby; if he does not, he must defend himself in ordinary actions at law, but without the defenses above named, and without limit as to how much a jury may award in damages. The only negligence of the employee which will bar recovery is "Willful misconduct."

At our election, in October, an amendment will be placed before the people to remove the optional phase of the act and make the acceptance of the fixed compensation compulsory. This form of legislation has become popular, not only in California but in many other States. There is no doubt that all concerned would be greatly benefited by regulations which would procure for the injured a larger portion of the amount paid by the employer. At present, much less than 50 per cent. reaches the injured. The balance is consumed in expenses. Much anxiety has been felt by employers on account of the act; but just how great a burden it may prove to be is yet to be demonstrated.

At our last meeting President Cline called attention to the desirability of a Public Service Commission for the State of California, along the lines of those established by other States. Two amendments to the Constitution have been approved for submission to the people in October: Assembly Constitutional Amendment No. 6, enlarging the number of Railroad Commissioners to 5; and Senate Constitutional Amendment No. 47, enlarging the powers of that Commission. This makes it optional for cities by majority vote to retain unto themselves the right to regulate public utilities as heretofore, and also to recover such right even after it has been surrendered to the State Railroad Commission.

It is to be regretted that California cannot have a Commission with complete control similar to the other progressive States where so much has been accomplished. The State of Nevada has adopted, and is now working, under a Public Service Commission very similar to the Wisconsin Commission, and, although its field of labor is limited, it is handling the problems in a progressive manner.

The absolute necessity for such a Commission is demonstrated in Los Angeles' experience. Their local Board of Public Utilities, clothed with extraordinary powers, was repudiated by the City Council in its desire to meet with popular approval after exhaustive investigation and report by high-priced experts.

The settlement of the San Francisco rate case, by compromise, has disposed of the most important litigation of interest to gas men. There have been many minor cases of damage, etc. The California District Court of Appeals, 115 Pac., 754; "Fair *vs.* Home Gas and Electric Company," has sustained the findings of the lower Court upholding the provisions of Section 629, California Civil Code, regulating the furnishings of service when the consumer is within 100 feet of the main.

The labor situation, so far as the gas industry is concerned, has been very satisfactory during the last year. The wonderful growth of all the cities on the Coast has required very extensive construction work, keeping large numbers of men employed during the entire year. While the agitator is always with us, I believe there exists a better feeling between the gas companies and their men than in almost any other calling.

Pursuant to instructions, given at the last Convention, a committee was appointed for the purpose of arranging for the "Congress of Gas Men," to be held in San Francisco during the Panama-Pacific Exposition in 1915. Invitations to participate have been sent to the general associations, and I believe a continuance of our effort will result in the greatest gathering of gas men ever convened.

At this time I wish to thank the officers of the Association for their hearty co-operation during the year, and especially in preparation for this convention. I also desire to thank those who have generously given their time in the preparation of the papers to be read before this meeting. Subjects of most vital importance are before us and I trust that all present will take an active part in their discussion.

## Photometry of Large Light Sources.

[A paper prepared by MESSRS. G. H. STICKNEY and S. L. E. ROSE, for the Fifth Convention, Illuminating Engineering Society.]

The purpose of this paper is to present some of the particular features involved in the photometry of large and powerful light sources, and to describe briefly some methods and elements of photometric construction which have been successfully applied in the illuminating engineering laboratory of the General Electric Company.

The material is drawn mostly from the experience of the authors in connection with this laboratory, under the direction of Mr. W. D'A. Ryan, which experience dates back to 1898. Since then there has been a gradual improvement in instruments and methods, and it was necessary to design, construct and operate a number of photometers for the measurement of practically every type of artificial illuminant in common use. In the photometry of large units the work has, in a large degree, centered around the development of the different forms of electric arc lamps, and the application of suitable reflectors to adapt them to the requirements of the various fields of lighting. Developmental tests have also been made in connection with adapting reflectors to incandescent lamps, especially lamps of the tungsten filament type.

With the removal of the laboratory from Lynn to Schenectady, in 1909, came the opportunity to build an entirely new equipment, embodying the previous experience and adapting the apparatus to the characteristics of the new illuminants which had been developed in recent years.

*Types of Photometers.*—There are two principal types of photometers: Namely, those in which the mean spherical candle power is observed at a single reading and those in which the intensity in any particular direction is read. The mean spherical photometers have the advantage of saving time in the determination of the mean candle power and, on such account, often give a more accurate indication of this value for a particular condition. In the work of this laboratory, however, the distribution of light, as well as the mean intensity, has been considered of prime importance; so that the distribution type of photometer has been used almost exclusively, the mean spherical intensity being calculated from the determined values. All the photometers described in this paper are of the distribution type. Distribution photometers are commonly built in three different forms: The constant length, constant intensity and constant radius photometers.

The constant length photometer is the oldest form in common use and is the simplest to construct. As the name implies, the length of the photometric axis is constant, being measurements made by varying the position of the photometer disk between the standard and the light to be measured.

In the constant intensity photometer, the distance from the standard to the photometric screen is fixed, and the distance, between the two and the light to be measured, is varied until the balance is obtained. This maintains the intensity on the photometer screen at a fixed value, which gives particularly accurate results for the class of readings to which this type of photometer is adapted.

In the constant radius photometer the distance between the light to be measured and the photometer disk is retained constant, while the distance to the standard is varied. This arrangement is particularly advantageous where the measurements are to be made on lamps equipped with reflectors or otherwise having a large area; so that there is more or less question as to how far the law of inverse squares will apply. When this point is in question, the readings are designated as "apparent candle power" at the distance for which the photometer is set. The mean spherical candle power, or total flux of light, can be calculated with reasonable accuracy from the results thus obtained. On account of that advantage, this form of photometer has been used almost exclusively in the laboratory for the past 6 or 8 years.

There are a number of methods for directing the light to the photometer disk; for example, in an instrument which has been used for a number of years at the Massachusetts Institute of Technology the entire photometer was pivoted at the photometer disk on a horizontal axis perpendicular to the photometric axis. The light unit to be measured was suspended at one end of the bar, so as to retain its vertical position with the center of illumination at a fixed distance from the disk. The standard was mounted upon a track at the opposite end of the bar, so that it could be controlled from the photometer disk. This photometer belongs in the constant radius class. Its radial distance is 10 feet. The arrangement was such that the light from any angle with reference to the test lamp could be measured directly on the photometer screen without the use of any mirrors.

Another ingenious constant radius photometer is in the "Electrical Testing Laboratories," New York.[1] In this photometer the disk is suspended on a arm and swung in a vertical plane around the lamp to be measured. The intensity of illumination on the disk is measured with the Sharpe-Millar photometer, the light being reflected into the instrument by means of a mirror mounted on the axis of the arm.

An interesting form of photometer[2] was used by Prof. Matthews in the arc lamp tests at Purdue University for the National Electric Light Association. In its original form, a ring of mirrors was arranged around the lamp to be measured perpendicular to the photometric axis. The mirrors were adjusted so as to reflect the light from the various angles of elevation on the photometer disk. This photometer could be used as a distribution photometer, by covering all the mirrors, excepting 1 or 2, at the elevation at which it was desired to make the measurement. The mean spherical candle power was read by exposing all of the mirrors, but coating them with an absorbing film to introduce the cosine factor. Considerable difficulty was experienced, however, in securing an accurate coating, and this was later improved in accordance with a suggestion by Dr. Steinmetz, whereby the absorption was obtained by a suitable screen inserted in front of the photometer disk.

1. For description, see lecture by C. H. Sharp, "Measurement of Light," in Lectures on Illuminating Engineering (Johns Hopkins University, 1910), Vol. I., p. 474.

2. Described and illustrated on p. 474, Vol. I., Lectures on Illuminating Engineering (Johns Hopkins University, 1910).

A similar form of photometer, used by Blondel and later by Matthews, had but two mirrors, pivoted and swung around the photometric axis. It was similar in principle to the twin-mirror photometer now in use in the Schenectady laboratory, which is more fully described later in this paper.

Another photometer has been designed primarily for the testing of lamps used in connection with large diffusing or reflecting surfaces up to 6 or 8 feet in diameter. It has not been built or installed up to the present time, although suitable space has been reserved for it in the Schenectady laboratory. A track runs the full length of the room about midway between the floor and ceiling, and supports two carriages similar to traveling cranes, one on each side of the lamp to be tested. On these carriages a photometer disk, standard lamp and seat for an observer are mounted as shown in Fig. 1. The lamp to

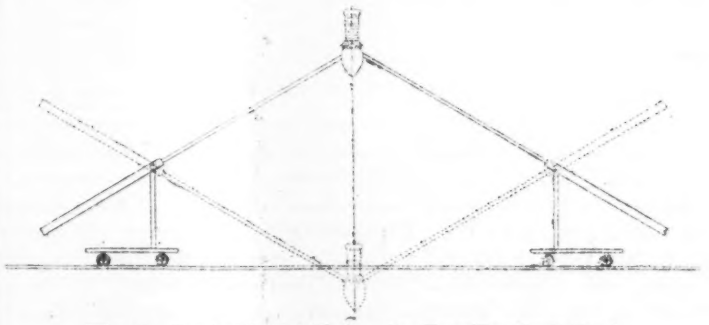

Fig. 1.—Constant Radius Photometer (Travelling Crane Type).

be tested is suitably suspended and tied to each carriage by an arm so that, as the lamp is raised or lowered, the carriages run forward or backward, always keeping the photometer disk at a distance of 10 feet from the center of light. Simultaneous readings are taken on both sides of the lamp.

A similar type of photometer which was used at Lynn is shown in Fig. 2. The unit to be tested was suspended, with its center of illu-

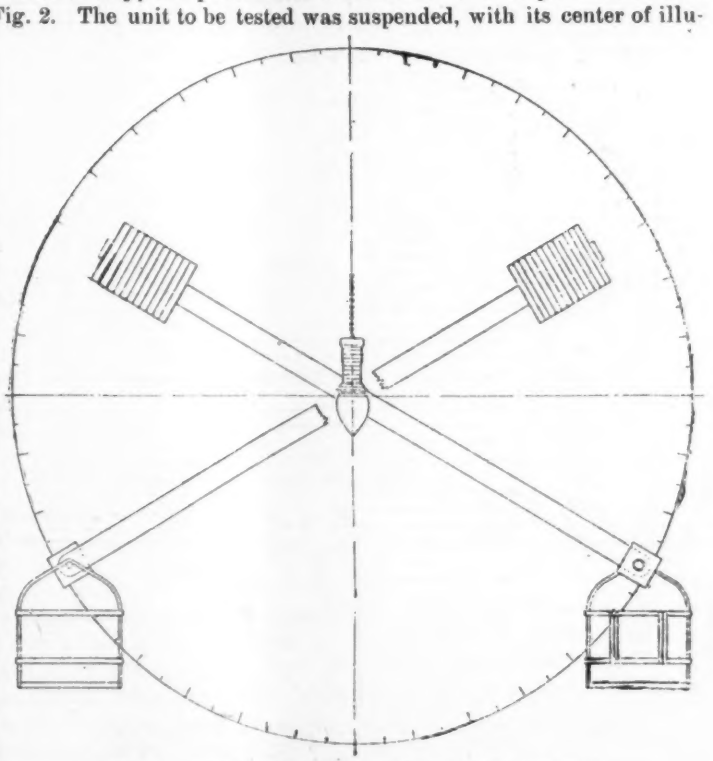

Fig. 2.—Constant Radius Photometer (Rotating Arm Type).

mination on a horizontal axis, about which two arms, one on each side of the room, were rotated. Each arm carried a small photometer and the observer, who propelled himself about the lamp by means of a handwheel, and suitable gears. Simultaneous readings were made on both sides of the lamp.

In the General Electric Company's laboratory, however, practically all the measurements have been made with two forms of photometer, the single-mirror, crane-type photometer and the twin-mirror photometer. Four photometers of the cran e type were erected and used successively when the laboratory was in Lynn. The last one (built about 1907) is illustrated in Fig. 3. In this photometer the sight-box was supported on a stand at a fixed point and supports were arranged

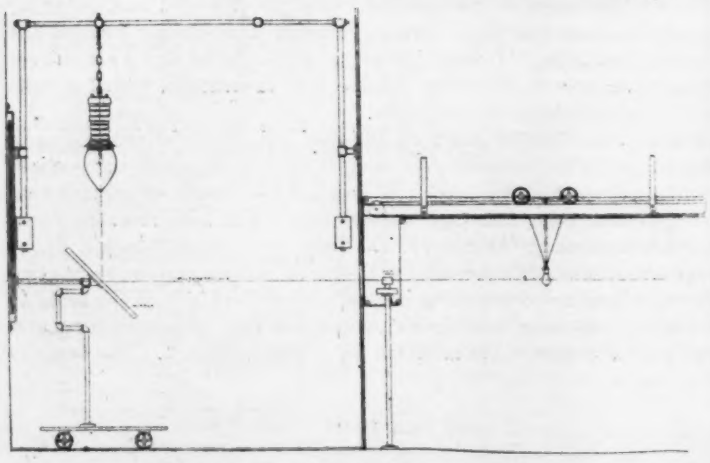

Fig. 3.—Single-Mirror Crane-Type Photometer.

on the crane so that tests could be made at a radius of 10 or 15 feet. The track carrying the standard lamp carriage was supported from the ceiling. A partition, with only a small opening on the photometric axis, prevented any direct or stray light from the lamp under test reaching the sight-box. The standard lamp carriage was motor driven and controlled by a suitable switch near the sight-box. Trouble was experienced in stopping the carriage quickly, which is necessary for quick settings, and this was later changed to hand control.

When the laboratory was transferred to Schenectady, in 1909, the twin-mirror photometer was adopted for the larger unit work. This photometer employs 2 mirrors mounted on arms which rotate about the photometric axis. Thus the centers of the mirrors are retained in a vertical plane perpendicular to the photometric axis at the center of the light source. The mirrors are set at such angle as to reflect the image of the light source on the photometric disk. This is shown diagrammatically in Fig. 4. The elevation sketch in Fig. 5 shows the mechanical arrangement of the photometer.

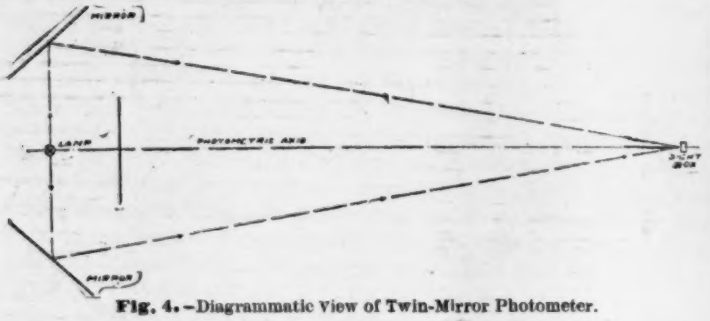


Fig. 4.—Diagrammatic View of Twin-Mirror Photometer.

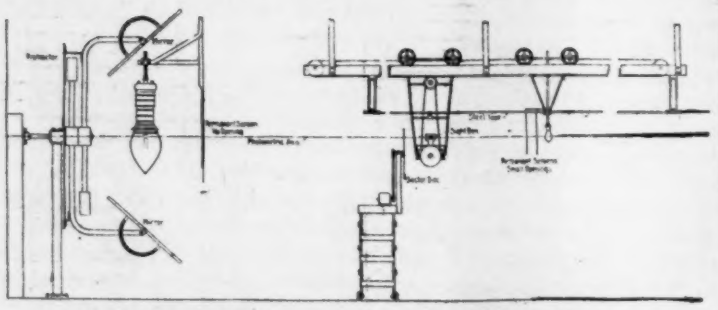

Fig. 5.—Mechanical Arrangement of Twin-Mirror Photometer.

The overhead track with suspended carriages is hung from the ceiling, which construction has the following advantages over the ordinary type. Track reflection is more easily eliminated. The room is not blocked up. The alignment is less affected by persons walking in the rooms and can be easily arranged for accurate adjustment.

The total length of the room is approximately 40 feet and the width 14 feet. The height varies from about 12 feet at one end to 18 feet at the other. The length of track is about 24 feet; the photometric axis approximately 5 feet 3 inches above the floor. The whole interior is painted a dull black. Suitable screens are used to prevent any reflected light from walls, floor or ceiling, or any other stray light, striking the disk of the sight-box or the eyes of the observer. The screen which cuts all direct light from the photometer disk is supplemented by a number of portable screens arranged so that they can be readily adjusted for the various conditions. A Lummer-Brodhun, contrast-type sight-box is mounted on a carriage suspended from the photometer track. Ordinarily this is securely fastened at a point which gives a photometric radius of 20 feet. The arrangement, however, is such that this radius can be changed within certain limits to suit requirements. Both the sight-box and the working standard lamp are provided so that they can be adjusted vertically in case realignment of the track becomes necessary. The working standard is moved back and forth in securing a balance by means of a belt mechanism operated by the observer through a hand-wheel situated below the sight box.

A steel tape, graduated in feet and tenths, passes around a pulley at each end of the track, and is securely fastened to the lamp carriage. A pointer in front of the observer indicates on the tape the distance between the standard lamp and photometric disk for each setting.

The mirrors are large enough to accommodate a lamp with a reflector over 3 feet in diameter. Fig. 6 shows a testing position, both

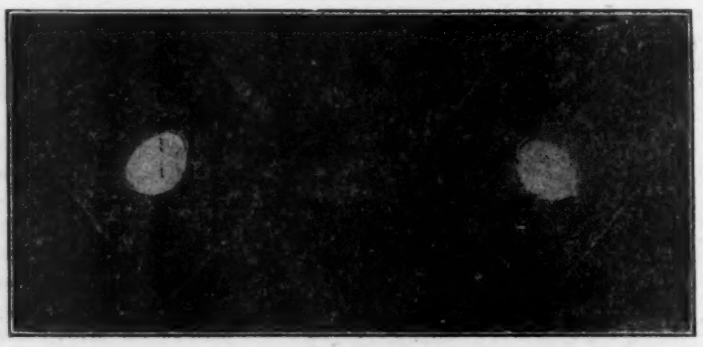

Fig. 6.—Photograph of Twin Mirrors Set at 50° from Vertical Axis.

mirrors being set at 50° from the vertical axis. Fig. 7 shows another

Fig. 7.—Photograph of Twin Mirrors Set at 110° from Vertical Axis.

testing position with the mirrors set at 110° from the vertical axis. These photographs were taken with the lens of the camera at the point that the disk of the sight-box occupies during the test. The large metal protractor for indicating the elevation of the mirrors can be seen, the screen having been removed in order to show it.

The sector disk is mounted on a portable stand arranged for vertical adjustment, which not only facilitates the changing of its position from one side of the sight-box to the other, but also prevents any vibration from the rapidly rotating disk being transmitted to the photometric apparatus. A single disk, driven by a small motor, has been used in preference to the adjustable disk because of its simplicity and accuracy of calibration. Using a sector disk, with a ratio of approximately 6 to 1, candle powers ranging from 12,700 down to 6 have been satisfactorily measured. By using a disk of higher ratio, an even wider range could be secured. The desirability of providing for so large a range is indicated by some of the recent tests. For example, a flame arc lamp gave, at its angle of maximum intensity, an average of over 3,000-candle power, and at its angle of minimum intensity, an average of slightly less than 100-candle power. In another test on projector arc lamps a candle power intensity of over 12,000 was readily measured with this photometer.

*Standard Lamps.*—Three classes of candle power standards are used, namely: Reference, substitution and working standards.

Reference standards consist of carbon incandescent lamps with a parallel type filament, furnished by the Electrical Testing Laboratories, of New York city, and verified by the Bureau of Standards at Washington. New reference standard lamps are purchased at fre-

quent intervals and interchecked with the older ones and with each other. These lamps are burned for only very short periods of time, and great care is taken not to apply a higher voltage than called for on the calibration.

Substitution standards consist of 250-watt, or other high candle power, multiple tungsten lamps, carefully seasoned and checked against 2 or more reference standards and against each other, without the use of mirrors. The mirrors and working standard lamps are calibrated at the same time by placing a substitution standard lamp in the photometer the same as any other lamp to be tested.

Working standards consist of 40-watt, multiple tungsten lamps, of special design furnished by the Electrical Testing Laboratories. These are checked against the substitution standards. Calibration tests are made frequently; at least once a week, and in some cases, daily. When the standards show any discoloration or change in candle power they are discarded.

A careful check has been made of the results obtained by different observers and also with other laboratories. It is advisable to do this as often as possible in order to prevent the creeping in of errors in readings or methods. It has, for some time, been the custom to check from time-to-time measurements of the so-called "arc lamp" or "large unit" photometer with the so-called "incandescent" or "small unit" photometer. This has been done by testing a tungsten filament lamp in both photometers. As these photometers are built on different lines, this tends to eliminate any local errors.

*Method of Test.*—The lamp to be tested is hung so that its center of illumination is, as near as possible, in the photometric axis. The lamp is then connected to the supply circuit and suitable meters inserted to give the necessary measurements of power, pressure, etc. Curve drawing meters are used to give a continuous record of volts, amperes or watts. Each lamp is warmed by a preliminary burning until it reaches a constant condition before a final check is made of adjustment and the photometric test started.

For all ordinary tests, lamps are operated under standard conditions and as near as possible at their commercial ratings. It is impracticable to operate all types of lamps at a constand adjustment, owing to instantaneous variations of longer or shorter duration. In such a case, narrow limits are assigned and photometric readings made only when the lamp is operating within the assigned limits. No definite rule can be set as the range of these limits may vary from different types of lamps. A number of photometric settings are made by different observers every 10 degrees throughout one or more vertical planes, starting at a point directly beneath the lamp.

After a careful investigation, the use of automatic recording devices has been abandoned, it having been found preferable to have the values called off by the photometrist and recorded by the observer in charge of the electrical instruments, meters, etc. This was found to avoid confusion in throwing out readings taken when the lamps were not operating under rated conditions.

Nearly all illuminants measured give an approximately symmetrical distribution of light. That is, practically the same candle power is emitted in all directions with respect to the vertical. This, of course, represents the simplest case in which the candle power measurements in a sing le vertical plane represent the values for all directions. Where the distribution of light is unsymmetrical, readings are made in three or more critical or intermediate planes, depending upon the amount of variation and its character. In such cases it is customary to plot several curves and also a mean curve. For curves representing types of lamps, tests are made on a sufficient number of electrodes, mantles or other parts to eliminate individual variation and the tests averaged to obtain the mean curve.

The sheets for recording the original readings taken during the test and the final data sheet from which the curve is made and the hemispherical and spherical candle power calculated are shown in Figs. 8, 9, 10 and 11. These are self-explanatory. For irregular curves where the variation of candle power from angle to angle is rapid, the mean spherical and hemispherical candle power values are obtained by means of a Rosseau diagram and planimeter. Wherever possible, however, the calculation method is used, since it is quicker and less liable to introduce personal errors which are difficult to discover.

*Elimination of Errors.*—The following are some of the more important details to which too much attention cannot be paid in order to eliminate all possible sources of error, both in calibrating and testng. A sufficient number of screens and proper placing of them to prevent stray light from reaching the disk in the sight-box or the

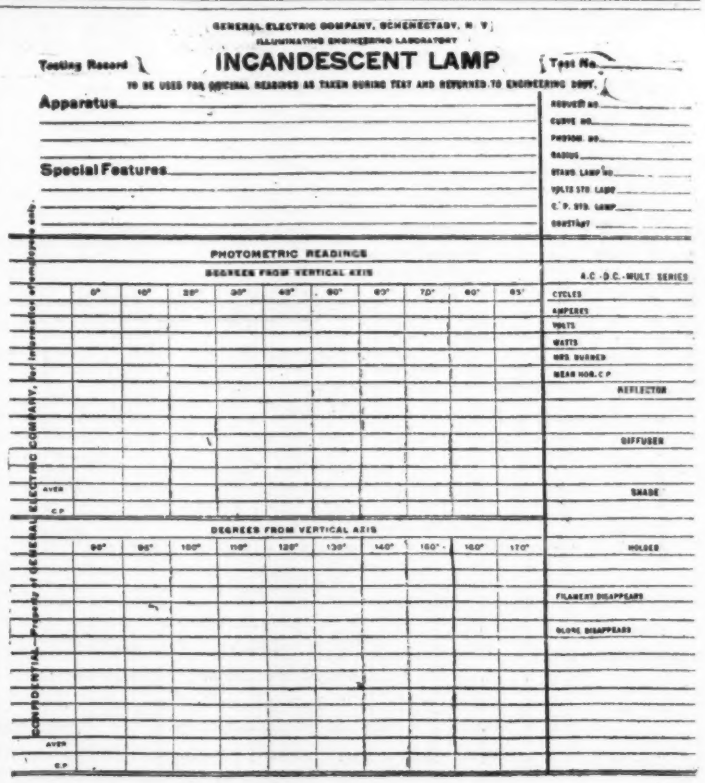


Fig. 8.—Record Sheet for Incandescent Lamps.

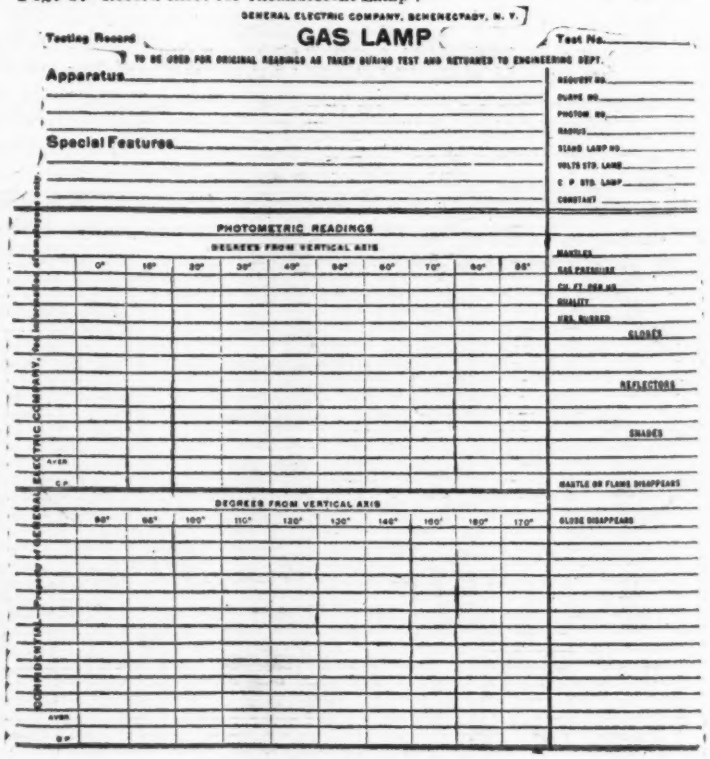


Fig. 9.—Record Sheet for Gas Lamps.

observer's eyes should be provided. Especially where very powerful lights are to be measured, it is important to watch every possible source of stray light. Even dull black surfaces may reflect sufficient light to affect the results when illuminated to a very high intensity. Photographs taken from the position of the photometer disk are of assistance as a final check in eliminating such discrepancies. The sight-box and standard lamp should be kept as free from vibration as possible. All meters should be carefully calibrated. For example, a 1 per cent. error in voltage may result in a 5 per cent. error in candle power, or even more. Meters of proper capacity should be used, *i. e.*, one should not try to measure 5 amperes on a 30-ampere meter. If possible, meters of such capacity that the needle is about the center of the scale should be used. For alternating current work, the proper frequency should be held constant during the test. All distances should be measured with an inextensible scale such as a steel tape. A large error in candle power may be introduced by measuring distances with a linen tape which has become

GENERAL ELECTRIC COMPANY, SCHENECTADY, N. Y.
ILLUMINATING ENGINEERING LABORATORY

Testing Record **ARC LAMP** Test No.

TO BE USED FOR ORIGINAL READINGS AS TAKEN DURING TEST AND RETURNED TO ENGINEERING DEPT.

Apparatus

Special Features

PHOTOMETRIC READINGS
DEGREES FROM VERTICAL AXIS

0° 10° 20° 30° 40° 50° 60° 70° 80° 90°

DEGREES FROM VERTICAL AXIS

90° 100° 110° 120° 130° 140° 150° 160° 170°

A.C.-D.C.-MULT.-SERIES
CYCLES
AMPERES
VOLTS TERM.
VOLTS ARC
WATTS TERM.
WATTS ARC
NOS. BURNED
GLOBES
MAKE
COLOR
REFLECTORS
DIFFUSERS
SHADES
ELECTRODES
TYPES
MAKES
ARC DISAPPEARS
GLOBE DISAPPEARS

Remarks:

Fig. 10.—Record Sheet for Arc Lamps.

GENERAL ELECTRIC COMPANY, SCHENECTADY, N. Y.
ILLUMINATING ENGINEERING LABORATORY

**SPHERICAL CANDLE POWER DATA** Test No.

Apparatus

Request No.
Curve No.
Date

LOWER HEMISPHERE

| Degrees from Vert. | C.P. | Constant |
|---|---|---|
| 0 | | .00381 |
| 10 | | .0302 |
| 20 | | .0596 |
| 30 | | .0872 |
| 40 | | .112 |
| 50 | | .133 |
| 60 | | .151 |
| 70 | | .164 |
| 80 | | .172 |
| 90 | | .0872 |

Volts Term.
Volts Arc.
Amp.
Watts Term.
Watts Arc.
Eno. Globe
Outer Globe
Reflector
Holder
Circuit
Frequency
Electrodes
Mean Lower Hem. C.P.

UPPER HEMISPHERE

| | | |
|---|---|---|
| 90 | | .0872 |
| 100 | | .172 |
| 110 | | .164 |
| 120 | | .151 |
| 130 | | .133 |
| 140 | | .112 |
| 150 | | .0872 |
| 160 | | .0596 |
| 170 | | .0302 |
| 180 | | .00381 |

Watts per M.L.H.C.P. =
M.L.H.C.P. per Watt =
Watts per M.S.C.P. =
M.S.C.P. per Watt =
Total lumens =
Downward lumens =
Total lumens per Watt =
Dwn'd lumens per Watt =
Mean Hor. C.P. =
Watts per M. Hor. C.P. =
Mean Upper Hem. C.P.
Mean Spherical C.P.

Calc. by
Checked by

Fig. 11.—Final Data Sheet.

stretched, or other scales which have become distorted. Standard lamps must be accurately set up; when stationary, a certain definite position with relation to the photometric disk must be maintained. Pressure leads must be extended direct from the voltmeter or wattmeter to the point at which it is desired to measure the voltage. Mirrors of the best quality of crystal glass and the thinnest plate must be used. They must be kept clean and free from scratches or other imperfections. Readings must be taken only when the lamp is operating at correct adjustment. If necessary, the lamp should be readjusted and the test started over again. In any photometer in which the light strikes the disk at a perceptible angle, care must be taken to make sure that the relation of the angle of view in the sight-box does not affect the results.

Practically all large light sources must, for mechanical reasons, be operated in a vertical position. Very few of them can be rotated without affecting their operation. This must be allowed for in the design and operation of the photometers. Especially if the area of the source is large, or if it is provided with reflectors so designed that there are one or more virtual light sources, it is desirable that the distance to the photometer disk should be as great as possible in order to minimize any errors due to the variation from the point source of light or discrepancies in locating the center of illumination. The size of the photometer is usually limited, however, by the space available and, with some forms of photometer, by the mechanical construction required.

*Characteristics of Light Sources.*—Proper consideration should be given to the requirements of the various lighting units. The photometer must be designed to accommodate conveniently the mechanical, as well as the luminous, characteristics of all the various light sources likely to be measured. The clearances must be sufficient to allow for various mechanical constructions, and the lamp suspension must be so arranged that the center of illumination of the lamp can be adjusted to the proper point on the photometric axis.

The real difficulties in the photometry of large units are those introduced by the variation in color and intensity of the light. Of these two the variation in intensity is the principal source of error, in measurement, and tests the judgment of the photometrist in assigning a fair value. Practically all large light sources are subject to changes in intensity. The light may vary more or less regularly and with longer or shorter periods. In some cases it is complicated by a wandering of the maximum light in various directions about the lamps. Variations which would hardly be noticeable to the ordinary observer make the reading of a photometer much more difficult. It is not uncommon to find readings varying from 20 per cent. of the mean to 300 per cent. An especially trying example is one of the forms of flame arc lamps which, for a period of time, gives a powerful yellow light and then, for another period of time, a weaker orange light. The question arises as to which value should be taken. For want of a better method of approximation, readings have been taken over a period of time sufficient to give a fair weight to each condition of burning and the average value determined. This is not entirely satisfactory, since the value of the light is not so great as that of a steady light of the same average intensity. On the other hand, particularly where the lamps are operated in groups, it is considerably above the minimum. Several years ago this situation was further complicated by the fact that, before the days of careful photometry, excessive candle power values were assigned to open arc lamps, and were so thoroughly associated with them that the conception of candle power by engineers and others was influenced by this rating. On this account, Mr. Ryan found it expedient, in 1901, to make comparisons between arc lamps in terms of the average maximum candle power, the values being so designated.[1] Later, when it became necessary to make comparisons between arc lamps and other illuminants, the average intensity was adopted, since the average maximum values did not apply. This change was followed by the adoption of the average value of comparison between arc lamps themselves.

Where the variation in intensity is rapid, it is difficult to obtain consistent readings. An inexperienced photometrist is inclined to follow the variation and thus obtain values higher or lower than the mean, depending upon his personal habit in setting and reading the photometer disk. Two methods have been followed in the laboratory to minimize errors in this respect. In some cases the maximum and minimum intensities have been measured and the mean determined. In other cases a large number of sharp, quick readings have been made at regular intervals and the values averaged. It is essential that the photometric balances should be made more quickly than the light varies so as to obtain an instantaneous value. With excessive variation, therefore, a photometer disk which can be read rapidly may give more accurate results than a more sensitive form requiring more time. On this account, in the single mirror photometers, used at Lynn, the best results were obtained with the Bunsen disk, while on the twin mirror photometer, at Schenectady, which has a tendency to steady the light on the disk, the Lummer-Brodhun (contrast screen) was found preferable. The advantage of the Bunsen disk in the former case was due to the absence of the telescope. By reducing the variation of intensity on the photometer screen, the twin mirror photometer has reduced the time and effort of reading and increased the

1. "The Relative Merits of Open and Inclosed Arc Lamps for Street Illumination." A paper read before the Ohio Electric Light Association, August, 1901.

accuracy. Check tests between the crane type and the twin mirror type photometers have checked exceedingly close in the average values obtained, while the variation between the measurements of a number of observers has been considerably less with the latter.

As explained elsewhere, either the carbon or tungsten filament incandescent lamp has always been used as a working standard. The color of light from practically all sources differs, in a greater or less degree, from that of these standards. While this difference in color makes it somewhat more difficult to make accurate settings, especially with inexperienced observers, it is surprising what facility and accuracy are attained with experience in setting the photometer. Moreover, with light sources of varying intensity, the color difference becomes almost insignificant on account of the fact that the accuracy of the readings cannot be as great as with steady sources. Some experiments were made several years ago with the flicker photometer, but partly on account of the chance of stroboscopic interference, its use was found to be inadvisable under the existing conditions.

Both the intensity and the characteristic of distribution of some forms of lamps vary, from time-to-time during their operating life. In some forms of arc lamps this is due to the change in the position of the arc with reference to the reflector or other parts of the lamp. In such cases it is desirable to run photometric curves at different periods during the life of the electrodes, this testing being designated as the "photometric-life test." In other forms of lamps the candle power varies rapidly for slight changes in the angle of elevation. This is generally due to the reflecting and cutting-off effects of the reflectors. An example of this is the luminous arc lamp equipped with a street reflector, which has a high maximum candle power at 80°, falling off rapidly as it approaches the horizontal. In the parts of the curve where the variation is rapid, readings are made every 2 or 3 degrees, although in general, where the variation is less rapid, an interval of 10° is maintained.

*Photometric Curves.*—Difficulty is frequently encountered in interpreting photometric curves due to lack of data and description of the conditions of the test. Fig. 12 shows a photometric curve derived

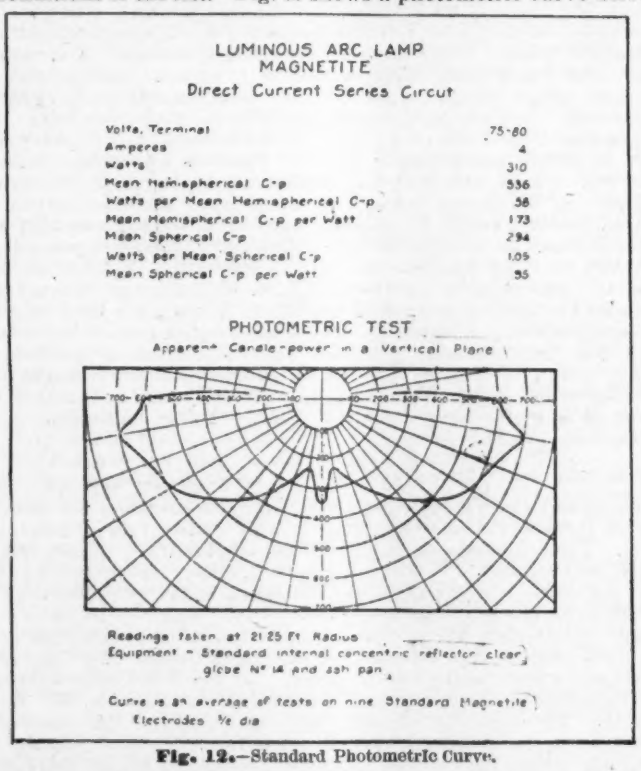
LUMINOUS ARC LAMP
MAGNETITE
Direct Current Series Circuit
Volts, Terminal 75-80
Amperes 4
Watts 310
Mean Hemispherical C-p 536
Watts per Mean Hemispherical C-p .58
Mean Hemispherical C-p per Watt 1.73
Mean Spherical C-p 294
Watts per Mean Spherical C-p 1.05
Mean Spherical C-p per Watt .95
PHOTOMETRIC TEST
Apparent Candle-power in a Vertical Plane
Readings taken at 21.25 Ft. Radius
Equipment - Standard internal concentric reflector clear globe No. 14 and ash pan
Curve is an average of tests on nine Standard Magnetite Electrodes 1/4 dia

**Fig. 12.**—Standard Photometric Curve.

from a representative test and illustrates the practice of this laboratory. Unquestionably the reliability and usefulness of such a curve are, to a large degree, dependent upon the accuracy and completeness with which such information is given.

## Recent Small Gas Lighting Units.

[A paper prepared by MR. F. H. GILPIN for the Fifth Convention, Illuminating Engineering Society.]

In the general development of the present systems of interior lighting by gas, especially in residences, necessity has arisen for more variety in small sized units.

The electrical interests have for some time supplied units of almost any size and to suit every need. Formerly it was 8, 16 and 32-candle power carbon units; later the same size in the metallized filament type and, lately, the 20 and 40-candle power tantalum and 20, 32 and 48-candle power tungsten units, which give an approximate mean spherical candle power of about 7, 14 and 28 for the carbon and metallized filaments and 17.5 and 34, and 17.5, 28 and 42 for the new filament lamps.

In contrast with this the gas industry has long contented itself with single inverted units of 50 mean spherical candle power and upright units of about 85 mean spherical candle power, all the arcs and larger lamps being mere multiples of these units. It is seen that the smaller of these units is larger than the largest incandescent electric lamp commonly used in the interior field.

German and English manufacturers were the pioneers in the development of a smaller unit that should occupy a position so that its light flux would be one-half that of the former smallest gas unit. The first development was an upright burner, but later, inverted burners of the "midget" type, so designed as to give about 25 mean spherical candle power, were introduced.

The field that is opened by the use of a small unit of this type can be readily apprehended. The introduction of the so-called junior upright burner opened the way for the replacement of a large number of open flame burners without requiring any change in fixture or glassware. This, however, did not to any great extent improve the effective distribution, especially in a majority of cases where the old glassware was adhered to, which emphasized the poor distribution by brightening the upper hemisphere and showing a greater contrast of light and shade than before. By slight changes it is possible in many cases to employ the new types of inverted "midget" lamps with their own glassware, which is usually designed to distribute the light flux to the best advantage.

Also, there arise situations where a 50 mean spherical candle power unit would give such a great excess of light as to make its use uneconomical. For such occasions the small unit is especially advantageous, and for this purpose its development should be continued.

During the last year and a half, or 2 years, several small gas lighting units of this type have been examined and tested in various ways to determine their usefulness under varying conditions. Seven of these lamps, lettered respectively A, B, C, D, E, F and G, will be compared and their relative efficiencies tabulated and discussed.

Lamps A and F are of German, B, D and G of English and C and E of American design. They show in approximately the same order the care taken in, and extra workmanship given to, the minor details of manufacture.

Table I. outlines the general points in which the construction of tho lamps differs as to the methods of introducing and regulating the gas and air supply to obtain a satisfactory mixture.

TABLE I.

| Lamp. | Gas Adjustment. | Air Adjustment. | Bunsen Tube. | Injector or Raceway. | Enlarged mixing Chamber. | Gauze. | Burner Tip. | Inner Cylinder. | Globe. |
|---|---|---|---|---|---|---|---|---|---|
| A | Yes Down | Yes | Straight | Yes | Yes | No | Magnesia | Draft | Closed |
| B | Yes Down | Yes | Injector shape | No | No | No | Metal | No | Open |
| C | Yes Up | No | Semi-circular | No | No | No | Metal | No | Air-hole |
| D | Yes Down | Yes | Straight | No | No | No | Porcelain | No | Open |
| E | Yes Down | Yes | Straight | No | Yes | No. 18 Mesh | Magnesia | No | Open |
| F | Yes Down | Yes | Straight | No | Yes | No | Magnesia | Draft | Closed |
| G | No Down | Yes | Straight | Yes | Yes | 1 No. 28<br>1 No. 24 | Metal | No | Closed |

A—Bunsen protected from products by partition in shell.
D—Lower half of Bunsen of porcelain.
E—Very long burner tip. Bunsen protected as A.
F—Thermostatic primary air control. Bunsen protected as A.
G—Mixing chamber filled with baffles to act as regenerator.

In Table II. are given the results obtained with these lamps at various pressures between 2.0 and 4.5 inches of water. All the values given have been reduced to the common equivalent of a clear glass globe by determining the relative absorptions of the various globes with which the lamps were originally equipped. This was done to enable a more satisfactory camparison of the various candle powers and efficiencies being made. All tests were made on an average mixed (coal and water) gas of a specific gravity of about 0.66 and a gross heating value of between 600 and 650 B.T.U. per cubic foot. In the last column is given an efficiency factor of lumens per B.T.U. This forms a very good method of comparison with the electrical rating of lumens per watt and gives as a basis an actual

(*Continued on page* 218.)

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NEW YORK, MONDAY, OCTOBER 2, 1911.

[Official Notice.]

## Sixth Meeting, American Gas Institute.

The Sixth Annual Meeting of the Institute will be held at St. Louis, Mo., on Wednesday, Thursday and Friday, October 18th–20th 1911.

The Headquarters will be in the Hotel Jefferson, and the meetings will be held in Memorial Hall, 19th and Locust streets.

The Committee on Arrangements has made preliminary plans for a banquet on Thursday evening, and an excursion on the river for Friday afternoon. The ladies will be entertained with an automobile ride and luncheon, Thursday noon, and a theater party on Thursday evening.

The Committee on Arrangements is composed as follows: C. L. Holman, Chairman; D. R. Russell, August Court, C. H. Quackenbush, A. C. Einstein, T. D. Miller, John Dell, C. H. Dickey, R. B. Hatton, R. A. Walsh, E. A. Downey, E. H. Boehnken.

### Hotel Rates.

| Hotel. | Single Room. Without Bath. | Single Room. With Bath. | Double Room. Without Bath. | Double Room. With Bath. |
|---|---|---|---|---|
| Jefferson | $1.50 day and up. | $2.50 day and up. | $2.50 day and up. | $3.00 day and up. |
| Southern | $1.00 day and up. | $2.50 day and up. | $1.00 day and up. | $2.50 day and up. |
| Maryland | $1.50 day. | $2.00 and $2.50 day. | $2.00 and $2.50 day. | $3, $3.50 and $4 day. |
| American | | $1.50 day and up. | | $2.50 day and up. |
| Planters | $1.50 and $2.00 day. | $2.50 day. | $1.50 day and up. | $2.00 day and up. |
| Marquette | $1.00 and $1.50 day. | $2, $3 and $3.50. | $1 each. | $1.50 each. |

| Hotel. | Rooms with 2 Beds, Without Bath. 2 People. | Rooms with 2 Beds, Without Bath. 3 or 4 People. | Rooms with 2 Beds, With Bath. 2 People. | Rooms with 2 Beds, With Bath. More than 2. |
|---|---|---|---|---|
| Maryland | $3.00 day. | $4.00 day. | $4.00 day. | $1 each for all over two. |

### Transportation.

*Railroad Rates.*—It will be impossible to secure convention rates on the certificate plan for this meeting, as the Passenger Associations have raised the minimum attendance for securing such rates to 1,000. But in many cases excursion tickets and mileage books can be used to advantage.

The Chairman of the Technical Committee announces the following papers to be read at the meeting:

"Intensive Scrubbing and Condensing of Gas," by L. E. Worthing, Detroit, Mich.

"The Manufacture of Illuminating Gas in By-Product Ovens in the United States," by W. S. Blauvelt, Semet-Solvay Company, Detroit, Mich.

"Report on Verticals at Providence, R. I.," by Carroll Miller, Providence, R. I.

"Report on Verticals at Manchester, N. H.," by W. G. Africa, Manchester, N. H.

"Turbo-Blower," by an Engineer with the General Electric Company.

"Production and Market for Sulphate of Ammonia," by an Engineer with the New England Gas and Coke Company, Boston, Mass.

"Tar Distillation and Market for Its By-Products," by Alan D. Whittaker, Atlanta, Ga.

"Actual Leakage in Unaccounted for Gas," by J. D. von Maur, St. Louis, Mo.

"District Holders and Their Place in a Distribution System," by R. M. Griswold, Denver, Col.

"Flow of Gas in Mains," by J. W. Battin, Detroit, Mich.

"U. S. Government Report on Electrolysis," by S. W. Stratton, Bureau of Standards, Washington, D. C.

"Pacific Coast Conditions," by John A. Britton, San Francisco, Cal.

"Photometric Work," by C. O. Bond, Philadelphia, Pa.

"Cost and Results Obtained from Automobile Delivery," by L. R. Dutton, Wyncote, Pa.

"Valuation of Public Utilities," by H. C. Abell, New York city.

There will also be some interesting Committee Reports, and the Report of the Editors of the Wrinkle Department and Bureau of Information. It is possible that arrangements may be made for a Lecture on "Some Recent Developments in Gaseous Combustion."

At a regular meeting of the Board of Directors, held August 19th, 1911, the following gentlemen were elected as the Nominating Committee: C. H. Nettleton, Chairman; Jas. H. Jourdan, W. H. Gartley, James Ferrier and J. H. Eustace.

In case of inability to serve, the following gentlemen were named as alternatives: J. A. Britton, T. C. Jones, C. M. Cohn, J. D. von Maur and H. M. Moore.

A. B. Beadle, Secretary.

[Special Editorial Correspondence by Telegraph.]

## FIFTH CONVENTION, ILLUMINATING ENGINEERING SOCIETY.

Congress Hotel, Chicago, Sept. 25, 1911.

Dear Journal: The Illuminating Engineering Society met in Fifth Annual Convention the morning of September 25th. The sessions were opened with Vice-President Lansingh in the Chair. In the unavoidable absence of the Mayor, Mr. John F. Gilchrist welcomed the delegates after the fashion now pretty well stereotyped. A pleasing response to the welcoming was uttered by Mr. Joseph D. Israel, of Chicago. In the absence of President Kennelly (who is now touring in Europe) his address, on "The Relations of Physico-Physiological Research to Illuminating Engineering," was read by the Vice-President. It was a scholarly compilation, albeit a trifle over the heads of some of his hearers. Next came the report of the "Committee on Nomenclature," which was read by Mr. Langdon, in the absence of Chairman A. J. Humphries. Again, through the absence of Chairman Louis Bell, the report was presented and read by Dr. Cobb. It was the "Progress Report," and its trend was to emphasize the value of the work done by the Society in advancing the art of illumination both in its divisions and as an entirety. The discussion on the paper was spirited and prolonged, prominent participators therein being Messrs. Barrows, Heminger, Cravath and Skiff, and Dr. Elliott. This carried us to recess. In the afternoon the first paper, which consisted of a "Symposium on Illuminating Glassware," in three parts, somewhat after the style of collaboration. Mr. Bassett Jones, who had the "introduction" as his share of the task, failed to come to hand; so Prof. Barrows presented the Bassett chapters. Part I. and Part III. respectively by Mr. C. H. McCormack and Mr. L. W. Young, were read (because of more "absences," by Messrs. Godinez and S. G. Hibben: Part II. however, was abstracted by its author, Mr. Albert Jackson Marshall. The final paper for the first day, on "An Analysis of the Requirements of Modern Reflector Design," was read by its author, Mr. F. C. Godinez. This presentation also brought out a brisk discussion. When I say that 187 members and guests have registered their attendance, it may be well understood that the sessions are not suffering through lack of auditors.—L.

The evening of Monday a reception and dance were brought off in the Florentine room. This was a most enjoyable function, the pleasures of which were at an end shortly before midnight. Light refreshments were served.—L.

Tuesday, Sept. 26, 1911.

The second day's proceedings were commenced under the direction of Vice President Ives, who certainly well knows how to handle the gavel. The discussion on the illuminated glassware papers was resumed and finished. It was notable for a clever speech by Mr. Norman Macbeth, who, by-the-way, continues still well seated in the thoughts of his old-time associates. Then came the paper, by Mr. George S. Barrows, whose theme was "Natural Gas: Its Production and Utilization." The author is to be congratulated over the effective way in which he treated the topic. In the discussion thereon a splendid chapter was submitted by that clever gentleman, Mr. W. H. Gartley. The topic of "Small Gas Light Units" was the matter dealt with in the number by Mr. F. H. Gilpin. This, of course, was especially interesting to the gas men present, of whom there were many. Next for consideration was the paper, by Mr. J. E. Randall, on "Recent Developments in the Manufacture of Incandescent Electric Lamps." This closed the Tuesday morning sitting. The afternoon was pleasantly taken up by visits to and inspection of several notable electric installations, these including the beautiful structure now being occupied as business headquarters for the Peoples Gas Light and Coke Company, the Commonwealth-Edison-Fisk street plant, the Sears-Roebuck Company building and the National X-Ray Reflector Company's quarters. In the evening a meeting of the Section officers of the Society was held, at which was had general discussion of routine Society matterr. The members-at-large engaged themselves in "squad inspection" of the street and advertising illumination.

Wednesday, Sept. 27, 1911.

Promptly at 10 the third day's business was commenced. The morning papers were considered in this order: "The Analysis, Performance and Cost Data of Illuminants," by Messrs. Ward Harrison and G. H. Magdsick; "The Evaluation of Lamp Life," by Preston S. Millar and L. J. Lewinson; "The Photometry of Lighting Units of High Intensity," by Messrs. G. H. Stickney and D. E. Rose.

The Millar paper was splendidly supplemented by an elaborate series of stereopticon slides. While the three topics named were discussed at length, the Millar discussion was especially entertaining, some of the participants being Dr. Ives and Messrs. Barrows, Macbeth, Cravath and Edwards. The afternoon was taken up most interestingly by considering the papers named in the following order: "Photometry at Low Intensities," by Dr. Louis Bell; "Effectiveness of Light as Influenced by Systems and Surroundings" (an especially able contribution), by Mr. J. R. Cravath. The banquet was served in the Hotel's "Florentine Room," and the settings for the feast, as well as the serving thereof, together with the music and the speeches, all constituted a scene of beauty accompanied by harmony, that was as it should have been. The weaker sex graced the occasion by their presence, and evidently spurred on Toastmaster Marks to flights of fancy oratory that almost caused him to be considered a composite Demosthenes-Lucullus—or of that type. Amongst the speakers were General Harries and Messrs. Gartley, Hyde, Niesz, Elliott and others.—L.

Thursday morning the order list called for further discussion of the Cravath paper, which was followed by the paper on "The Distribution of Luminosity in Nature," read by Dr. Ives. These papers were then read and discussed: "The Law of Conservation as Applied to Illumination Calculations," by Dr. A. S. McAllister—this was nicely punctuated with lantern slide pictures; "Resume of Legislative Enactments on Illumination," by Mr. E. Leavenworth Elliott—this was particularly well received; and the final on "Illumination or Equipment," by Frank Rae, Jr.—it was read by Mr. Marshall. All of this matter properly resulted in a hearty vote of thanks to the Chicago Section for the completeness of their arrangements for and over the entire meeting. And following the voiced sentiments of Dr. Ives that they had just closed the "greatest convention" the Society ever held, the sessions were declared odjourned. The weather was ideal, the attendance at the technical sessions was marked for number, punctuality and attention. The registered attendance was: Members, 142; guests, 93—17 of whom were of the weaker sex—and 41 different cities were represented.—L.

## BRIEFLY TOLD.

ENTERTAINMENT FEATURES, DENVER MEETING, NATIONAL COMMERCIAL GAS ASSOCIATION.—We are indebted to the executives of the National Commercial Gas Association for these particulars respecting the matters named in the heading:

Two special *de luxe* trains, over the Burlington route, one leaving Chicago, Sunday, October 22d, at 5 P.M., arriving at Denver the following evening, at 7:30, and the other, starting from St. Louis, the afternoon of Saturday, October 21st, arriving at the Denver Union Depot, Sunday, October 22d, at 5:35 P.M., have been arranged by the Transportation Committee. The St. Louis train was scheduled for the convenience of the members attending the meeting of the American Gas Institute in that city. Each of these trains will carry the finest of modern equipment, including standard drawingroom sleepers, with electrically lighted berths, club car, diner, dynamo baggage car and one of those luxurious lounging cars, containing club buffet, library, observation rooms and glass inclosed sun parlor. Daily papers, current magazines and souvenir postal cards will be at the disposal of all on these trains. Everything has been arranged for a comfortable trip westward. Delegates contemplating the Denver trip should make plan to arrive in Chicago or St. Louis in time to take one or the other of the special trains westward.

The route of the Chicago Special will, for the most part, run through the better part of the corn belts of Illinois, Iowa and Nebraska—that vast agricultural section which in recent years has contributed so much of the Nation's bread and meat.

The St. Louis train will closely follow the western bank of the Mississippi to Hannibal, then directly across Missouri to St. Joe, along the line of the old historic Hannibal and St. Joe Railroad, thence closely paralleling the Kansas-Nebraska boundary line, west to Oxford, from which point the route will be the same as that of the Chicago Special.

The Entertainment Committee at Denver will send out advance men to meet the specials and direct the passengers to their respective hotels on reaching Denver.

An informal reception will be held in the new office building of the Denver Gas and Electric Light Company, Monday evening, October 23d. This will afford an opportunity for the delegates and their ladies to renew old acquaintances and meet all the others in attendance. Plans will be made so that registration can be made throughout the evening.

The amusement features scheduled for the convention week are of a variety that will insure thorough entertainment for everyone. During the business sessions, Tuesday, October 24th, the ladies will be entertained by an automobile trip over the city, including visits to the City Park Museum and various points of interest. A luncheon will be served at the "Country Club," the ladies being returned to their hotels in time for dinner. In the evening all the delegates and ladies will attend a theater party at one of the local playhouses.

The afternoon of Wednesday, October 25th, the ladies will be taken on a trip to the foothills in sight-seeing cars, and thus given an opportunity to view the mountain scenery near Denver. In the evening they will be entertained at a theater party at another of the local playhouses. On this evening all the delegates will attend an athletic smoker at one of the Denver clubs. The special programme is being determined and should prove one of the memorable events of the entertainment.

For the evening of October 26th no formal entertainment plans have been scheduled, but arrangements will be made so that the delegates and ladies may take rides through the lighted sections of Denver, including a trip over the business section and through the boulevards and parks, giving the visitors an idea of the illumination of the celebrated "City of Lights."

The Committee urges all in attendance to stay over for the features of Friday, Saturday and Sunday, all of which are planned to give the visitors an opportunity of viewing the scenic attractions of the Rocky Mountain region.

For Friday, an all-day trip into the mountains will be the special feature. The special train will convey the party over the famous Moffat Road, to the land of perpetual snow on the top of the Continental Divide, where a game dinner of bear meat, venison, grouse and mountain trout will be served.

The delegates and ladies will go by special train to Colorado Springs, Saturday, October 28th, leaving in the morning, and will be conveyed on a sight-seeing trip through Colorado Springs and eventually reaching the far-famed "Garden of the Gods." A "chuck-wagon" dinner will be served inside the gateway, in true Western style; also, a wild west cowboy show will help pass away the morning. In the afternoon the party will be taken, by carriages or burros, up the South Cheyenne Canon, visiting the "Seven Falls" and different points of interest en route. The other features on the programme for the afternoon are visits to Manitou, with its celebrated mineral springs, and a trip up the incline railway to the top of Mount Manitou.

The following morning (Sunday, October 29th) the party will proceed by rail over the Cripple Creek Short Line to Cripple Creek, a basket luncheon being served on the train. On reaching the town the party will visit some of the notable gold, silver and lead mining properties. The trip to and from Cripple Creek is one of intense interest and beauty, in that it has many views of mountain and plain scenery which without a doubt include some of the most beautiful on the Continent.

In urging attendance at the Denver convention, the Entertainment Committee requests that the delegates bring the ladies with them. The entertainment features are planned to include many which will be of special interest to the ladies, and promises are made that all who come will be well repaid for making the trip.

Tickets, entitling the holder to all of the entertainment events, will be $12.50 for the men and $9 for each lady, including all entertainment features other than the railroad fare between Denver and Colorado Springs, and hotel accommodations at the latter place; or $7.50 for each man and $4 for each lady in attendance for all entertainment features up to and including the trip over the Moffat Road on Friday.

Although the actual expense of the entertainment programme is much greater than the price of the tickets, the hospitality and liberality of the Colorado members and business interests have made it possible to carry out this lavish programme.

CURRENT MENTION—

MR. JOSEPH MAYER, who has for some time held the position of Purchasing Agent to the Peoples Gas Light and Coke Company, of Chicago, has been appointed Commercial Agent to the Company, vice Mr. John C. D. Clark, resigned.

"B.," WRITING from Boston, Mass., under date of the 27th ult., says: Mr. H. B. Harriman, formerly Sales' Agent on the staff of the Lowell (Mass.) Gas Light Company, has been appointed Sales' Agent for the Lewiston (Me.) Gas Company.

The Framingham (Mass.) Gas, Fuel and Power Company has just planned out a comprehensive scheme of construction work for the coming year. The scheme includes the erection of a gasholder up to retaining 250,000 cubic feet, an up-to-date going over of its coal gas plant, and the addition of a complete water gas outfit to its generating division. It is also proposed to hook up the remodeled Framingham plant, by means of high pressure lines to the plants at Natick and Norwood. Along these lines it is likely that many customers will be picked up en route. These will be given service direct from the lines, controlled by individual governors, while the ordinary users will be served from the existing storage holders.

MR. SPEAR'S service with the Ruud Mfg. Company, as Manager of its Boston office, ended Saturday last, and to-day assumes the duties of Manager of the Boston headquarters of the Beler Automatic Water Heater Company. Mr. Spear's successor in the Ruud ranks is Mr. Holman.

THE result of the reorganization of the Amherst (Mass.) Gas Company is appended, the outcome of the change in its ownership, recently reported in the JOURNAL: Directors, Philip Cabot, Joseph W. Stevens, L. E. Flint, Henry S. Thompson and David Barry; President, Philip Cabot; Treasurer and Secretary, Henry S. Thompson; Assistant Treasurer, L. E. Flint; Superintendent, E. E. Willard.

MR. G. R. PAIGE has been appointed Sales' Manager for this territory by the Atlas Paint Company, of Nashville, Tenn. His headquarters will be in 103 Park avenue, Manhattan.

THE staff members of the Consolidated Gas Company, who are to attend the St. Louis meeting of the American Gas Institute, will travel per the train leaving the Pennsylvania Station, this city, at 6:32 P.M. of October 16th. This train is known as the "St. Louis Limited," and it needs no description at our hands.

(*Continued from page* 215.)

measurable quantity of mechanical energy of input compared to a physiological measure of useful output.

TABLE II.

| Lamp Pressure. | Constant. | Mean Spherical Candle Power. | Mean Spherical Candle Power Per Cubic Fee't. | Lumens. | Lumens B.T.U. Per Hour. |
|---|---|---|---|---|---|
| A—1.5 | 1.44 | 35.8 | 24.86 | 450 | 0.467 |
| 2.0 | 1.62 | 41.0 | 25.31 | 515 | 0.496 |
| 2.5 | 1.63 | 42.8 | 25.89 | 538 | 0.508 |
| 3.0 | 1.63 | 43.4 | 26.64 | 545 | 0.522 |
| 3.5 | 1.66 | 43.7 | 26.18 | 549 | 0.514 |
| 4.0 | 1.77 | 45.1 | 25.50 | 567 | 0.500 |
| 4.5 | 1.94 | 46.9 | 24.18 | 583 | 0.474 |
| 5.0 | 2.01 | 47.8 | 23 78 | 601 | 0.466 |
| B—2.0 | 1.10 | 29.2 | 26.44 | 367 | 0.507 |
| 2.5 | 1.31 | 35.9 | 27.40 | 451 | 0.524 |
| 3.5 | 1.57 | 40.3 | 25.66 | 506 | 0.491 |
| 4.5 | 1.85 | 42.3 | 22.89 | 532 | 0.438 |
| C—2.0 | 1.16 | 15.2 | 15.00 | 191 | 0.303 |
| 2.5 | 1.30 | 17.4 | 15.03 | 219 | 0.304 |
| 3.5 | 1.16 | 20.3 | 15.59 | 255 | 0.316 |
| 4.5 | 1.39 | 23.0 | 16.55 | 289 | 0.335 |
| D—2.0 | 1.01 | 25.4 | 24.70 | 319 | 0.471 |
| 2.5 | 1.15 | 27.7 | 24.10 | 348 | 0.461 |
| 3.5 | 1.21 | 29.0 | 23.95 | 365 | 0.459 |
| 4.5 | 1.35 | 31.7 | 23.47 | 399 | 0.449 |
| E—2.0 | 1.40 | 27.8 | 19.90 | 350 | 0.378 |
| 2.5 | 1.73 | 35.0 | 20.20 | 440 | 0.384 |
| 3.5 | 1.83 | 36.0 | 19.70 | 453 | 0.374 |
| 4.5 | 2.06 | 40.0 | 19.40 | 503 | 0.369 |
| F—2.0 | 0.97 | 21.7 | 22.36 | 273 | 0.439 |
| 2.5 | 1.21 | 22.5 | 18.58 | 283 | 0.364 |
| 3.5 | 1.38 | 23.6 | 17.10 | 297 | 0.331 |
| 4.5 | 1.47 | 22.8 | 15.46 | 287 | 0.300 |
| G—3.0 | 0.551 | 6.7 | 12.19 | 84 | 0.255 |
| 4.0 | 0.62 | 11.7 | 18.87 | 147 | 0.391 |
| 6.0 | 0.711 | 16.8 | 23.62 | 211 | 0.490 |
| 8.0 | 0.882 | 21.0 | 23.86 | 264 | 0.495 |
| 10.0 | 0.982 | 24.4 | 24.86 | 317 | 0.516 |
| Average of 18 larger units | | | 17.77 | | 0.345 |

It will be noted that with the exception of C and G all the lamps gave a uniformly high efficiency, showing a maximum at what is generally accepted as normal pressure, that is between 2.0 and 2.5 inches of water. This efficiency is higher by about 25 to 30 per cent. than that shown at the bottom of the table as the average efficiency obtained from 18 units designated as "larger" and having an approximate mean spherical candle power of 50. The exceptions in the cases of the lamps cited may be readily explained. In lamp C the curved Bunsen tube and primary air ports are of such design that at normal pressure a supply of primary air sufficient for good combustion of the gas necessary to fill out the mantle cannot be entrained; consequently, as the pressure is raised, the jet velocity, due to the greater constriction of the orifice, is increased and a larger volume of air, in proportion to the volume of gas entrained, and better combustion are obtained.

In lamp G the gas and air are previously mixed in the proportion of two volumes of gas to three volumes of air and by suitable mechanical apparatus the mixture is supplied to the lamp at a considerable increase above the normal operating pressure for low pressure lamps.

As previously noted, the efficiency of the small units is from 25 to 30 per cent. above that generally obtained from similar units of larger size. This effect may be due to various causes, but one reason is the relative temperatures of the mantles.

In order to form some idea of the extent to which the mantle causes this difference of efficiency between the large and the small units, a short investigation was made of the relative flame and mantle temperatures of two lamps of the same make but of different sizes. The same procedure was followed in testing both lamps. A new lamp was erected and fitted with a new mantle that appeared to be of average size and shape by inspection, no glassware being used. After burning off the mantle the lamp was adjusted at 2.5 inches pressure to a point of maximum brilliancy. After the lamp and mantle had become thoroughly heated temperature readings were obtained at uniform distances on the surface of the mantle by means of a platinum-rhodium thermo-couple, having a bead of 0.028 in. (0.71 mm.) diameter and standardized in connection with a milli-voltmeter. The mantle was then removed and without readjustment temperature readings were taken in a similar manner on the surface and in the interior of the flame. The dimensions of the free flames were also ascertained. The mantle was then replaced and check measurements made.

In Fig. 1 are shown full size sketches of the flames and mantles,

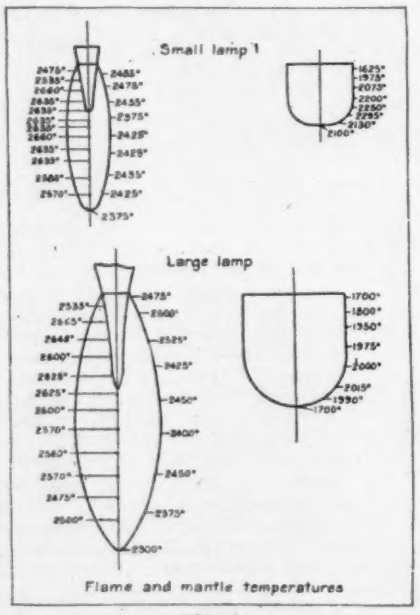



**Fig. 1.**

with the temperatures recorded. The averages show the remarkable difference in mantle temperatures obtained with practically the same unconfined flame temperatures:

TABLE III.

| | 25-C.P. Unit. | 50-C.P. Unit. |
|---|---|---|
| Gas | Mixed. | Mixed. |
| Pressure | 2.5 in. | 2.5 in. |
| B.T.U.'s of gas | 675 | 675 |
| Consumption (cubic feet) per hour | 1.67 | 3.50 |
| Average flame temp. °F. (abs.) | 2,988 | 2,979 |
| Average mantle temp. °F. (abs.) | 2,542 | 2,352 |
| Projected luminous area | 0.65 sq. in. | 1.97 sq. in. |
| Surface area | 2.53 sq. in. | 6.66 sq. in. |
| Volume mantle | .491 cu. in. | 1.935 cu. in. |
| Volume free flame | .353 cu. in. | 2.128 cu. in. |
| Weight (sq. in.) mantle ash | .06392 grms. | .0628 grms. |
| Total weight luminous mantle | .16172 grms. | .45821 grms. |
| B.T.U.'s per hour per 0.1 gram ash | 697 | 515 |

In the ratio of B.T.U. per hour per 0.1 gram ash may be found the solution of the higher temperature and efficiency.

The increase of heat added per unit weight of ash is $\frac{182}{492} \times 100 =$ 37.0 per cent.; the increase of temperature is $\frac{190}{2,352} \times 100 = 8.1$ per cent., and the approximate ratio of energy emitted $= \frac{(2,552)^4}{(2,352)^4} = 1.365$ or an excess of 36.5 per cent. As the lamps cited, with the exceptions of C and G, show a relative efficiency of $\frac{0.458}{0.345} = 1.355$, the analogy between the heat supplied, radiation theoretically expended, and the luminous efficiency is very close. Again, the ratio of the free flame volume to the inclosed mantle volume may have some relation to the temperature to which the mantle may be raised. In case of restricted outflow between the mantle ring and burner nozzle, combustion may be incomplete, while with too large an opening an excess of air may be entrained and the temperature of the mantle may not reach the possible maximum. In any case, the temperatures of the flames obtained by properly burning a uniform sample of gas should be the same, independent of the sizes of the flames, provided that the air supply can be regulated with sufficient accuracy. It has been found from several tests that a lamp equipped with a mantle having a low weight of ash per unit area gives a considerably higher efficiency than one equipped with a heavier mantle. The limited range of this short experiment does not warrant the forming of a definite theory, but the comparison is of interest, inasmuch as it apparently corroborates the actual photometric efficiencies obtained.

The extent of one's knowledge of any type of lamp should not end here. It should not be restricted to the determination of the initial efficiency and the character of the distribution curve. The characteristic that is of greatest value in determining the utility and advan-

tage of one type over another is its ability to endure continuous use, maintaining a high percentage of its original efficiency and preserving its mechanical properties over a considerable period of time.

At least three elements determine the success of a gas unit. First, the point having possibly the greatest importance is the mantle. On its mechanical structure and chemical saturation depend its ability to withstand shocks and hard use. Here is where the installation not under maintenance shows most conspicuously its deterioration. Secondly should be considered the structure of the burner itself. On the smoothness of the interior finish depends the amount of trouble caused by stoppage due to the accumulation of dirt and dust, fouling of orifices and gauzes and the corrosion of important parts. These troubles may at any time be beyond immediate remedy and result in the condemning and discarding of the lamp. Third, while less trouble is incident to the breakage and soiling of glassware, yet care should be taken in the design, so as to permit of easy removal for replacement by cleaning. The first two points mentioned are of great importance, inasmuch as they are beyond the control of the average user of gas and directly affect the performance of the lamp.

As a criterion of the possibilities of these lamps, when operated under actual service conditions, each lamp was subjected to what might be termed a maintenance period test of 10 days. The lamps were burned for 5 hours each day, using a uniform gas at a constant pressure, making a total burning time of 50 hours. No change of adjustment was made during this period, unless absolutely necessary, and each lamp was operated with the equipment supplied. Upon removing the lamps from the test a first candle power measurement with efficiency determination was made with the lamp in the condition as found and a second reading obtained after all the glassware had been thoroughly cleaned.

Whenever a lamp showed unusual promise a further "life test" of 1,000 hours continuous burning was resorted to, slight changes in adjustment being made from time to time when necessary.

A summary of the short tests is given in Table IV., and the special 1,000-hour tests in Table V.

The common electrical practice is to consider a lamp as having outlived its usefulness when the candle power has fallen below 80 per cent. of the initial value. There is no reason why this should not be considered good practice in the gas lighting industry. This suggestion is not made with the idea that a new lamp should be supplied, but that when the value of a lamp falls below the 80 per cent. limit it should be thoroughly cleaned internally as well as externally and put back into service. The loss in candle power due to the collection of dust and dirt on the glassware and the protecting shades should not be charged against the lamp, as the depreciation resulting from this source will be on an average, under reasonably clean conditions of use, between 8 and 10 per cent. during 1,000 hours. As shown in Table IV. the loss due to other causes than accumulation of dust on the glassware during a maintenance period depends to a great extent on the condition of the mantle. One lamp actually showed a gain in candle power, while all the others, with the exception of lamp C, showed a net candle power loss of between 3 and 5 per cent. The mantle in lamp C was considerably carbonized at the end of the run, a condition accounted for by reasons stated under the discussion of the lamp construction. The losses due to solid glassware were variable on account of greatly different atmospheric and interior conditions at the times of the tests. In the 1,000-hour test the net loss was considerably less than 20 per cent., though the actual loss was greater.

Some effort was made in connection with the 1,000-hour service test to find a relation between the loss in candle power and the weight

TABLE IV.

| Lamp. | Constant. | Before Test. Mean Spherical Candle Power. | Mean Spherical Candle Power, Cubic Feet. | Lumens. | Lumens. B.T.U. | | After Test of 50 Hours. Constant. | Mean Spherical Candle Power. | Mean Spherical Candle Power Cubic Feet. | Lumens. | Lumens B.T.U. | Loss in Candle Power Per Cent. | Loss in Efficiency Per Cent. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A | 1.61 | 42.4 | 26.35 | 532 | 0.515 | *c* | 1.68 | 39.1 | 23.25 | 491 | 0.455 | 8.0 | 11.5 |
| | | | | | | *d* | 1.42 | 28.6 | 20.15 | 359 | 0.395 | 32.5 | 23.2 |
| B | 1.10 | 29.2 | 26.44 | 367 | 0.507 | *a* | 1.18 | 31.5 | 26.71 | 396 | 0.552 | +1.0 | +8.1 |
| | | | | | | *b* | 1.18 | 33.0 | 27.95 | 415 | 0.578 | +5.3 | +12.2 |
| C | 1.01 | 15.2 | 15.00 | 191 | 0.303 | *a* | 1.03 | 8.0 | 7.74 | 101 | 0.157 | 47.4 | 47.7 |
| | | | | | | *b* | 1.03 | 11.7 | 11.39 | 147 | 0.232 | 22.5 | 23.2 |
| D | 1.03 | 25.4 | 24.70 | 319 | 0.471 | *a* | 1.01 | 22.2 | 22.75 | 279 | 0.459 | 12.3 | 3.0 |
| | | | | | | *b* | 1.01 | 24.3 | 24.15 | 306 | 0.500 | 4.5 | +5.5 |
| E | 1.72 | 35.6 | 20.70 | 447 | 0.400 | *a* | 1.72 | 33.5 | 19.50 | 428 | 0.378 | 5.9 | 5.5 |
| | | | | | | *b* | 1.74 | 34.5 | 19.80 | 434 | 0.384 | 3.1 | 4.0 |
| F | 1.21 | 22.5 | 18.58 | 283 | 0.364 | *a* | 1.11 | 19.2 | 17.18 | 241 | 0.347 | 14.6 | 4.6 |
| | | | | | | *b* | 1.11 | 21.7 | 19.53 | 273 | 0 397 | 3.7 | +9.2 |
| G | No test | .... | .... | ... | ..... | .. | .... | .... | ..... | ... | ..... | .... | .... |

A = Readings taken with dirty glassware. B = Readings taken with glassware clean. C = After 50 hours, glassware not cleaned. D = After 250 hours, glassware not cleaned. + = Gain.

TABLE V.—(*Values not corrected for opacity of glassware.*)

| Lamp. | Constant. | Initial. Mean Spherical Candle Power. | Mean Spherical Candle Power Cubic Feet. | Lumens. | Lumens B.T.U. | | After 1,000 Hours. Constant. | Mean Spherical Candle Power. | Mean Spherical Candle Power Cubic Feet. | Lumens. | Lumens B.T.U. | Loss in Candle Power Per Cent. | Loss in Efficiency Per Cent. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A | 1.89 | 38.0 | 20.10 | 477 | 0.383 | *a* | 1.80 | 23.2 | 12.89 | 291 | 0.254 | 38.9 | 33.6 |
| | | | | | | *b* | 1.80 | 26.2 | 14.55 | 329 | 0.287 | 31.0 | 25.0 |
| B | 1.02 | 15.6 | 15.29 | 196 | 0.292 | *a* | 1.05 | 12.0 | 11.43 | 151 | 0.226 | 23.0 | 22.6 |
| | | | | | | *b* | 1.06 | 13.5 | 12.73 | 169 | 0.251 | 13.4 | 21.4 |
| D | 1.36 | 22.4 | 16.48 | 281 | 0.314 | *a* | 1.23 | 17.5 | 14.22 | 220 | 0.281 | 21.8 | 10.5 |
| | | | | | | *b* | 1.25 | 19.5 | 15.60 | 245 | 0.308 | 12.9 | 2.0 |
| E | 1.50 | 32.6 | 21.71 | 409 | 0.414 | *a* | 1.69 | 25.5 | 15.09 | 320 | 0.298 | 21.8 | 28.0 |
| | | | | | | *b* | 1.69 | 28 0 | 16.56 | 351 | 0.327 | 14.0 | 21.0 |

*a* = Before cleaning glassware. *b* = After cleaning glassware.

*Average Performance.*

| | Lamp A. Candle Power. | Lamp A. Efficiency. | Lamp B. Candle Power. | Lamp B. Efficiency | Lamp D. Candle Power. | Lamp D. Efficiency. | Lamp E. Candle Power. | Lamp E. Efficiency. |
|---|---|---|---|---|---|---|---|---|
| First hour | 38.6 | 0.383 | 15.6 | 0.292 | 22.4 | 0.314 | 32.6 | 0.414 |
| 1,000th hour (dirty) | 23.2 | 0.254 | 12.0 | 0.226 | 17.5 | 0.281 | 25.5 | 0.298 |
| Average | 30.6 | 0.319 | 13.8 | 0.259 | 20.0 | 0.298 | 29.1 | 0.356 |
| First hour | 38.0 | 0.383 | 15.6 | 0.292 | 22.4 | 0.314 | 32.6 | 0.414 |
| 1,000th hour (clean) | 26.2 | 0.287 | 13.5 | 0.251 | 19.5 | 0.308 | 28.0 | 0.327 |
| Average | 32.1 | 0.335 | 14.6 | 0.272 | 21.0 | 0.311 | 30.3 | 0.370 |
| Unit value | 30.0 | ..... | 15.0 | ..... | 20.0 | ..... | 30.0 | ..... |
| Absorption of globes | .... | ..... | 27.1 per cent. | | 30.0 per cent. | | .... | ..... |

of the mantle per square inch. As numerous mantles having a unit weight of about 0.069 grams per square inch had shown exceptionally good results in life and candle power, this weight was adopted as a temporary mantle standard. Other mantles have been examined that showed a very high initial candle power and efficiency, but a very short life. These were found to have a low weight per unit area and were designated as "flash." In the 1,000-hour test the weights of the mantles as found were:

| Lamp. | Weight of Mantle per Square Inch. |
|---|---|
| A | 0.05000 grams. |
| B | 0.04004 " |
| D | 0.05624 " |
| E | 0.06392 " |

The life-test results obtained are not in strict accordance with the "flash" mantle theory, inasmuch as the lightest mantle gave as satisfactory results as the heavier ones.

There may be a lower unit weight that would be satisfactory for use with the smaller mantles, owing to the mantle's greater structural strength, due to its smaller size and consequently less strain on the fibers near the ring. This, however, is a point as yet undetermined, though the results obtained above, which are strangely at variance with the larger units under the same conditions, show a marked tendency towards such a theory. However, further experience in this direction would be necessary to prove the point one way or the other.

In addition to the small inverted burners, several of the upright type have been used for comparison. These should also be considered in the general selection of small gas units. Four burners are listed below and described.

Lamp H is an American type, previously described before this Society by Mr. Macbeth, with an extra section added to the mica chimney.

Lamp I is a medium sized unit of German manufacture.

Lamps J and K are of English origin. Both lamps are of the same design, but one has about twice the lighting value of the other, though their actual size is very nearly the same. Lamp J may be considered a 25, and lamp K a 50-candle power unit.

In Table VI. is given a summary of the efficiencies of these lamps obtained under similar conditions to those given for the inverted types, and in Table VII. are shown the results of the 50 hours maintenance period tests similar to the ones cited for the inverted lamps.

TABLE VI.

| Lamp. | Pressure. | Constant | Mean Spherical Candle Power. | Mean Spherical Candle Power Per Cu. Ft. | Lumens. | Lumens Per British Thermal Unit. |
|---|---|---|---|---|---|---|
| H— | 2.0 | 2.28 | 36.9 | 16.18 | 464 | 0.320 |
| | 2.5 | 2.39 | 39.2 | 16.40 | 491 | 0.324 |
| | 3.5 | 2.60 | 42.8 | 16.46 | 537 | 0.325 |
| | 4.5 | 3.15 | 44.7 | 14.19 | 561 | 0 281 |
| I— | 1.5 | 2.15 | 40.8 | 18.98 | 502 | 0,385 |
| | 2.0 | 2.31 | 51.3 | 20.40 | 644 | 0 414 |
| | 2.5 | 2.89 | 55.2 | 19.10 | 693 | 0.388 |
| | 3.5 | 3.53 | 59.5 | 16.85 | 746 | 0.342 |
| | 4.5 | 3.97 | 64.0 | 16.12 | 803 | 0.328 |
| J— | 1.5 | 0.94 | 17.6 | 18.70 | 221 | 0.366 |
| | 2.0 | 1.12 | 23.0 | 20.50 | 289 | 0.402 |
| | 2.5 | 1.26 | 28.4 | 22.50 | 356 | 0.440 |
| | 3.5 | 1.52 | 33.5 | 22.00 | 420 | 0.430 |
| | 4.5 | 1.70 | 37 2 | 21.90 | 467 | 0.428 |
| K— | 1.5 | 2.08 | 28.5 | 13.70 | 357 | 0.268 |
| | 2.0 | 2.45 | 45.0 | 18.36 | 565 | 0.360 |
| | 2.5 | 2.86 | 54.0 | 18.87 | 678 | 0.370 |
| | 3.5 | 3.38 | 62.5 | 18.48 | 784 | 0.362 |
| | 4.5 | 3.78 | 69.3 | 18.33 | 870 | 0.357 |

Here again is encountered the same tendency of the smaller units to give a considerably higher efficiency than the larger ones. A striking comparison is shown in the results from Lamps J and K. These two lamps are identical in every particular of design, but the small unit gives a 20 per cent. higher efficiency than the larger one. The low efficiency of lamp H is due in a great part to the higher absorption by the mica chimney.

TABLE VII.

*Before Test.*

| Lamp. | Constant. | Mean Spherical Candle Power. | Mean Spherical Candle Power. Cu. Ft. | Lumens. | Lumens B.T.U. |
|---|---|---|---|---|---|
| H— | 2.28 | 36.9 | 16.18 | 464 | 0.320 |
| I— | 2.89 | 55 2 | 19.10 | 693 | 0.388 |
| J— | 1.26 | 28.4 | 22.50 | 356 | 0.440 |
| K— | 2.86 | 54.0 | 18.87 | 678 | 0.370 |

*After Test of 50 Hours.*

| Lamp. | Constant. | Mean Spherical Candle Power. | Mean Spherical Candle Power. Cu Ft. | Lumens. | Lumens. B..T.U. | Loss in Candle Power. Per Cent. | Loss in Efficiency. Per Cent. |
|---|---|---|---|---|---|---|---|
| H | a—2.42 | 33.8 | 13.92 | 424 | 0.287 | 8.4 | 11.5 |
| | b—2.39 | 35.7 | 14.93 | 448 | 0.308 | 3.2 | 3.8 |
| I | a—2.98 | 54.9 | 18.43 | 689 | 0.361 | 0.6 | 7.0 |
| | b—2.98 | 55.1 | 18.48 | 691 | 0.362 | 0.2 | 6.7 |
| J | a—1.31 | 29.3 | 22.40 | 368 | 0.454 | +3.2 | +3.2 |
| | b -1.31. | 30.2 | 23.10 | 379 | 0.469 | +6.3 | +6.6 |
| K | a—2.92 | 55.2 | 18.90 | 693 | 0.370 | +2.2 | +3.8 |
| | b—2.92. | 57.2 | 19.57 | 718 | 0.397 | +5.9 | +7.3 |

a before cleaning. b after cleaning. + gain.

In the "maintenance" period test some remarkable results were obtained, especially with lamps J and K. These lamps show a positive increase in both candle power and efficiency.

The question of mantles again enters into the results. The weights of the mantles with which these upright lamps were equipped are given below:

Lamp H = 0.05500 grams per square inch.
Lamp I = 0.03624 " "
Lamp J = 0.06528 " "
Lamp K = 0.06380 " "

In addition, the mantles J and K were hardened before being collodionized. This will account partly for the increase in candle power and efficiency during the first 50 hours.

The loss due to dirty glassware is only about 60 per cent. of that incurred with the inverted types.

In all types of the small units danger due to the breakage of glassware is greatly diminished and the possibly resultant damage reduced. The increase in efficiency means a decrease in consumption and results in what might be considered a cooler installetion.

Finally, further attention should be paid to increasing the number of sizes of lamps available, the investigations being so directed as to produce higher efficiencies at usual gas pressures.

## Illumination or Equipment?

[A paper prepared By MR. FRANK B. RAE, JR., for the Fifth Convention, Illuminating Engineering Society.]

There is this peculiarity about the lighting business; we sell gas, electricity or lighting equipment; whereas the customer buys, or thinks he buys, illumination. Between the buyer and seller, then, there is a gap, and it is my understanding that the Illuminating Engineering Society's purpose is to bridge this gap.

Now, into any problem of bridge-building enter many considerations. In the first place, the bridge must be erected where the density of traffic will repay in largest measure the cost of the structure. Then it must be of such strength and size, either large or small, as will most economically accommodate this traffic. These are plain and practical considerations which interest the sordid and the ignorant. The higher problems of engineering involved are, on the other hand, technical considerations which interest, chiefly, only a few men of special training.

To apply the simile to the lighting industry, we find it necessary to bridge the chasm between the man who sells gas, electricity and equipment and the man who buys illumination. The technical problems involved are of interest only to engineers, but there are plain and practical questions which interest the least ethical salesmen, the most sodden proletarian: Where are these bridges to be built?—How large or small are they to be?

To answer these questions, the engineers must, voluntarily or perforce, look at the problems first from the public's standpoint, which is something that has not been done heretofore with any consistency. You, as engineers, must realize that you are public servants like the driver of a taxicab or a subway guard; that is to say, a perhaps unwilling servant, but in livery nevertheless. The public does not know or care about your technical problems or difficulties, and does not propose that those difficulties shall be considered above the main point—which is to erect where most needed the bridges that will accommodate the necessary traffic.

Let us analyze for a moment the work of the man who to-day is selling equipment or energy, but who should be selling illumination. At the present time there is a simple formula for determining the amount of current required for lighting to a given intensity a room of given dimensions. This formula divides wall and ceiling tones into three classes; light, medium and dark, but it fails to define the meaning of the words "light, medium and dark" and takes no a

count of color. This lack of definiteness makes the formula a mere "rule of thumb" (which rule, you may remember, defines the distance from the first joint to the tip of the thumb—any thumb—as one inch).

Here then is a point where the engineers should throw a bridge over the chasm of our ignorance. We require a color chart with proper constants for determining exactly the value of wall tints.

Then, this situation is frequent. A man desiring to illuminate his premises is bombarded by the conflicting claims of many equipment manufacturers. The customer does not care at all what equipment he installs; his desire is simply to secure the best practical illumination. Yet there is no means whereby he can determine the exact facts regarding illuminants, for no data is available which either applies to normal working conditions or which bears the stamp of absolute independence.

So there is another bridge to be built.

Finally, the engineers can perform the greatest service of all by supplying, in usable form, data which may serve as the basis of popular education on illumination. In the industrial field, especially, we should know such things as the ratio in speed and spoilage between a workman operating under proper illumination and one combating the glare effect of a bare lamp hung directly in line of vision.

In this connection, let us examine briefly certain work that was done to promote industrial lighting.

Several years ago when the Holophane Company acquired the D'Olier steel reflectors it directed the writer to inaugurate a campaign of education in industrial lighting. Editors were interviewed; photographs were secured and articles prepared. Since the product exploited could be used only in conjunction with incandescent lamps, the work was frankly partisan to that illuminant. No excuse is offered for this other than the obvious commercial necessity of the case. Before the campaign was fairly launched, the Buckeye Electric Company, with whom I am also associated, joined forces in this work. Our purpose was to show the need for better industrial lighting conditions; to show the cost, in human eyesight, in waste time and in spoilage, of goods in process of manufacture, of inadequate lighting methods; and finally to explain, so far as practicable, the way to go about improving conditions by the use of incandescent lamps.

I am no engineer, but, gentlemen, three-quarters of the facts and figures which were cited in these educational articles which appeared in the textile, steel, shoe and similar trade papers, were the deductions of my crude and unscientific observation. The comparatively few "scientific" facts available were so generally at variance with the obvious truth that practically all such data had to be corrected by a "common sense constant" to make it pass muster.

Now, here is the nub of this recital. There is to-day very little more practical, usable data of actual scientific value on this subject than there was three years ago. Certain engineers have deplored the exaggeration, the inaccuracies, the generalities of the articles we have published, but they have not supplied the cold, hard, incontrovertible facts to supersede the only basis upon which we were compelled unwillingly to work.

The unregenerate ad-man, the boastful and seemingly unscrupulous salesman, have been compelled to erect flimsy and temporary bridges across this chasm which separates the manufacturer from his customer. They have done so, not out of choice, but from necessity; they are subjects, not for blame, but for succor.

It is hoped that these suggestions make clear the need for increased activity upon the part of this Society along lines of practical development of the field.

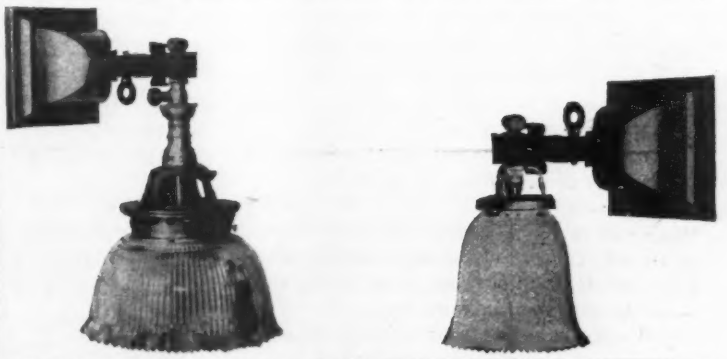
Such activity will be appreciated—is appreciated to-day. The successful salesman of gas, electricity or equipment knows that he must base his sales arguments upon results rather than means. Comparatively few lighting installations are sold to-day except from an engineering basis. The members of this Society may shudder at the blasphemous use here made of the word "engineering," but however mistakenly applied, the intent of the modern salesman of energy and equipment is to work along scientific lines and to employ such engineering data and principles as he can grasp. He may pervert these data to selfish ends, but if the data is fundamental and practical it will stand upon its merits. No one can take liberties with absolute truths—and few commercial men are so foolish as to try.

The difficulty, as it appears to me, is that the true engineers are overly interested in engineering for its own sake rather than for the sake of the public. Realizing their superiority (in this single subject) their effort is to rise further from the mass of humanity rather than to assist humanity to reach their level. This mental attitude is not peculiar to illuminating engineers; it obtains among other professions also. The highly trained musician despises those simple melodies which you and I appreciate and love. The experienced painter is so engrossed in brush-strokes and technique that the masterly rendering of an ugly subject to him excels in interest the simple translation of beauty in form and color.

Yet the great men in all professions and in all ages have been those who have simplified the involved and clarified the obscure. That, gentlemen, is your duty, if we are all to sell illumination instead of equipment.

## Management & Commercial Methods.

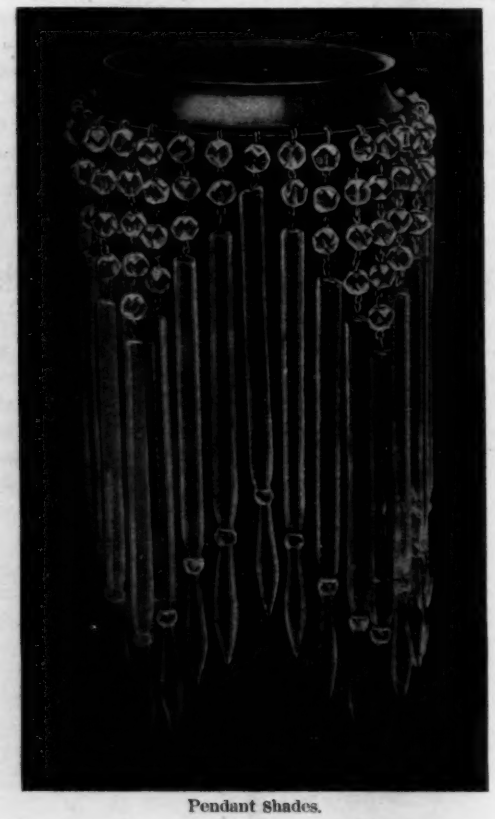
AN INTERCHANGEABLE GAS FIXTURE.—A fixture, the main attraction respecting which is that it can be used for 2 or 4 burners, the burners being either of the upright or pendant sort, is finding favor in the market, the introducers being the F. W. Wakefield Brass Company. One of the desig ns, listed as the Square Type and another (a bracket) are shown in the illustrations. The simplicity of the



lines of these fixtures makes the interchangeable feature a possibility without in any sense detracting from their appearance. From a purely commercial point of view these fixtures are quite acceptable in that a small stock is required to fill a variety of needs.

A NEW TYPE OF SHADE.—The custom of using inner cylinders with inverted mantle lamps has led to an increase in the styles and types of practical and ornamental glassware that may be used. One of the

more attractive samples of these is known amongst the trade as the pendant shades, of which three types made by O. O. Friedlaender are illustrated herewith. The prisms and beads are evolved in a large



Pendant Shades.

variety of shapes, colors and designs, and will undoubtedly prove a welcome addition to our present line of illuminating glassware.

## Recent Patent Issues.

Prepared for the AMERICAN GAS LIGHT JOURNAL by ROYAL E. BURNHAM, solicitor of patents and counselor in patent causes, 833 Bond Building, Washington, D. C., from whom illustrations and specifications of any patent mentioned below may be obtained for 10 cents.

1,003,524. Gas Producer. S. B. Sheldon, South Bethlehem, Pa.

1,003,615. Street Gas Lamp. S. F. Kraus, Denver, Col., assignor to the Kraus Light Company, same place.

1,003,887. Apparatus for Recovering Ammonia. A. B. Duff, Pittsburgh, Pa.

## Items of Interest
### FROM VARIOUS LOCALITIES.

THE Western Gas Construction Company is under contract to construct, at the East Station of the Washington (D. C.) Gas Light Company, a storage tank up to retaining 500,000 gallons of oil. The tank is to be completed by December 1st.

THE current dividend rate on the shares of the Quincy (Mass.) Gas Light Company is at the rate of 1¼ per cent. for the quarter; an advance of ¼ per cent.

MR. WILLIAM BRUCE CABELL, as Chief Counsel to and for the Maryland Public Service Commission, has reported to that body that, after a careful analysis of the charter of the Hagerstown (Md.) Light and Heat Company, he finds no warrants in law through which the Company may supply gas to its employees at a rate lower than that given to its ordinary customers.

AT the annual meeting of the shareholders in the St. Joseph (Mo.) Gas Company, the following officers were elected: Directors, W. A. P. McDonald, L. C. Burnes, W. P. Fulkerson, Emerson McMillin, James Campbell, C. A. Pfeiffer, Henry Krug, Jr., John Donavan and C. A. Milton; President, Emerson McMillin; Vice-President, W. A. P. McDonald; Secy.-Treas., F. Labrunerie; General Manager, Kerr Murray Mitchell.

MR. O. L. LEWIS, of Shelbyville, Ills., is authority for the statement that an up-to-date plant is to be built forthwith at Pana, Ills., and that the expenditure on such account will closely approach to $75,000. Pana (handsome spot though it is) ought certainly secure a model gas works at the named expenditure.

"THAT capable gas man and clever executive, Mr. Charles Dudley Lamson, whose management of the affairs of that great corporation, the Worcester (Mass.) Gas Light Company, has been lengthy, modern and successful, is again to the fore with an announcement that the Company proposes to share its business gains with its customers. The concession as publicly announced, is this: 'On and after January 1, 1912, the price of gas furnished by the Worcester Gas Light Company will be 95 cents per 1,000 cubic feet, with a discount of 20 cents per 1,000 on all bills that are paid on or before the 15th of the month in which they are presented, thus making the net price of gas 75 cents per 1,000 cubic feet. This price is for all consumers.'—B."

"B. M. M.," writing from Everett, Mass., under date of the 23d ult., says: "Dear JOURNAL—Would you believe it? Some of the 'labor-engineers' attached to the distribution forces of the Malden and Melrose (Mass.) Gas Company received orders the other morning to put in a gas service to a house on West street. They pocketed the 'orders,' marched to the scene, disturbed the earth, laid bare a main, and tapped it. 'Engineer' O'Shea was the party who made the tap, and when the drill penetrated the pipe wall a stream of water spurted out that laid the tapper in the ditch, and prostrated his 'fellow engineers,' Brennan and Cosgrove; the ditch, of course, was speedily a quagmire. The leak sadly embarassed the factory of the Boston Rubber Shoe Company, for the punctured pipe was its water service. Employees of the city water department soon restored matters to a condition bordering on the normal. But, could you believe it?"

MR. C. D. BOND, of the staff of the Citizens Gas Light Company, of Quincy, Mass., has been appointed Director of Boys' Work by the Trustees of the Y. M. C. A., Quincy, Mass.

THE Worcester (Mass.) Gas Light Company, through its Board of Directors, recently perfected the following executive management: President, Charles D. Lamson; Treasurer and Clerk, James P. Hamilton; General Manager, Dana B. Barnum. The Directors are: The officers and Messrs. Thomas B. Eaton, S. B. Woodward, A. George Bullock, Francis H. Dewey and Albert Wood.

THE New York, New Haven and Hartford Railroad Company is to construct the gas plant at Greenwich—that is, the great railroad concern will award the contracts and furnish the money. One of its engineering staff—Mr. Minor—has made the necessary surveys, and Mr. Fox, who has managed the electric lighting concern in Greenwich for some years, will act as local representative. The main plotting conveys the idea that the first gas service will be laid on in the Belle Haven and Rock Ridge sections.

"HERE'S one for you, a raw one, too. A gentleman named G. W. Hull, having determined to attempt political preferment, found it necessary to employ one or more spellbinders to properly present to the people of the districts in and about Hartford, Conn., some reasons why his aspirations should become realities through the medium of their votes. One of the aforesaid binders rejoices in the name of Jacob Rawiszer, and while it is not an euphonious cognomen, nevertheless it is more up-to-date than if it were Rawwaszer. Be that as it may, however, the binder was binding in Bristol some evenings ago, and in the course of his bindings found it necessary to refer in caustic speech to the franchise granted by the last Legislature to the promoters of the Terryville Gas Company. 'Now,' said the binder, 'That franchise was worth thousands of dollars to the State; in fact, I'll give $5,000 for it offhand, yet the State gets not a penny for it.' Mr. P. H. Condon, one of the gentlemen interested in the aforesaid franchise, hunted up Mr. Rawiszer the following morning and offered him the franchise for $5,000; and, finding the binder rather unresponsive, declared he would considerably shade the price for cash. Eventually the binder declined to have anything at all to do with the franchise, on the ground that he knew nothing about the gas business. Yet statements of such nature are uttered with clap trap freedom, often to the injury of both localities and their residents!—B. B. M."

ATTORNEYS representing the Macon (Ga.) Gas Company appeared before the Railroad Commission of Georgia, on the 22d ult., and argued for the sanctioning of a petition filed by the Company, under which it seeks authority to issue $200,000 of common stock and $600,000 bonds, the proceeds to be used in reconstruction and extensions. Amongst the improvements listed is a holder and new purifying apparatus, also large extension of mains have been plotted. The petition sets out that this is part of the reorganization plan of the Macon Gas Light and Water Company, which is changing its corporate name to the Macon Gas Company, as a sequence to its retiring from the water business, that occurred last Saturday, when the city took over that business for operation on municipal account. There was no opposition, and the Commission took the matter under advisement.

THE franchise granted to the Brockton Gas Light Company, under which it is authorized to supply gas in the adjoining settlement of Randolph, Mass., was signed by Selectmen McDonald and Dunphy, Selectman Desmond refusing to concur. His refusal was based on the fact that he favored a distinct and separate set of promoters. However, the signers were sufficient to make the franchise valid. Various clauses in the agreement are: The Company in laying its mains will give preference to local labor and town teamsters, 8 hours to be a day's work, and the rate to be the rate paid by the town. The price, net, shall not exceed $1.25 per 1,000, to July 1, 1914, when the price shall be put at a figure not in excess by 15 cents of the price paid by the people of Brockton at that time, which rate is to rule for all succeeding periods thereafter.

THE Directors of the Louisville (Ky.) Lighting Company have chosen Mr. P. T. Glidden General Manager, succeeding Mr. A. M. Worthington, who retires on account of ill-health.

"G. M. R.," writing under date of the 26th ult., informs us that the Eastern Blau Gas Company is about to establish a central generating plant in Portland, Me., and is in the market for a 100,000-foot holder, oil tank, scrubbing apparatus and station meter.

WE are in receipt of a good, working example" of a protractor-ruler, which came to us with the compliments of the Cruse Kemper Company, of Ambler, Pa. It is a beauty, and in acknowledging its receipt we assure the senders that we certainly can, and will, "Use it to advantage." Possibly, the Company has a few other specimens that others could use to advantage.

THE capital stock of the Danbury and Bethel (Conn.) Gas Company is to be increased to $525,000, and that of the New Britain (Conn.) Gas Company is to be increased to $1,000,000.

THE Wisconsin State Railroad Commission has issued an order that the bills for gas sent out the 1st inst. by the Manitowoc Gas Company shall be figured on the basis of $1 per 1,000 cubic feet net, a concession of 5 cents from the rate heretofore prevailing. This action was originally prompted by the proprietors of the Company.

A CORRESPONDENT in Detroit, writing under date of the 23d ult., says: "I intended mentioning to your Mr. Cunningham, on the occasion of the meeting of the Michigan Gas Association here this week, that an amicable settlement had been reached by the Common Council and the Holland City Gas Company, under which the former will desist from constructing a plant to be operated on municipal account, and the latter agrees to complete a series of extensions and improvements intended to increase facilities on all accounts. In return the Company is granted an amendment to its franchise, by means of which the 90 cents per 1,000 rate will prevail until the annual consumption reaches 100,000,000, instead of the 50,000,000 per annum output heretofore named as the changing point."

THE party named Calvin Wyatt, or General Organizer of the American Federation of Labor, and whose special mission in this vicinity just now is to disorganize the labor forces of the Consolidated Gas Company of New York, through the medium of "unionizing" them, recently declared that the average wage of the Company was decreased when the 80-cent gas rate became effective. The truth is this: The 80-cent rate became effective December 1, 1906; whereas the following May an order of the Company became operative by virtue of which the wages of all its employees, in receipt of $2,000 or less per annum, were advanced 10 per cent.

THE Central Maine Power Company has acquired control of the Waterville and Fairfield, Waterville and Oakland and the Union Gas and Electric Companies, which gives to the purchaser complete control of the water powers of the Bellgrade (Me.) chain of lakes; also, steam plants aggregating 5,000-horse power. The Managers of the respective points are: At Skowhegan, C. J. Abbey; at Waterville, Ralph J. Patterson; at Augusta, W. S. Wyman.

"B. S. M.," writing from Portsmouth, N. H., under date of 25th September, says: "The proprietors of the Portsmouth Gas Company, with the plan in view of economically handling its rapidly increasing business, has purchased the property known as the Philbrick wharf, off Water street, where a new plant is to be constructed, of course of modern type. The plans include a storage holder (to rest in steel tank) up to retaining 100,000 cubic feet. The old plant on Bow street will eventually be dismantled—it was originally commenced in 1850, and some of its 'sections' can hardly be denominated as modern. All this construction will likely be gone on with in 1912. To tell the truth, Manager Seybolt has had a busy, uneven time of it in keeping things going, especially when it is remembered that the storage facilities, aggregating 75,000 cubic feet, are afforded by means of 3 separate vessels."

THE Geneseo (N. Y.) Gas and Electric Light Company has been granted a franchise, to run for 25 years, the exchange cousideration therefor being an agreement between the authorities and the Company, that the latter will carry on a service of electric current during the 24 hours.

WE are informed that the proprietors of the Derby (Conn.) Gas Company have arranged for the taking down of the somewhat desultory group of frame structures going to make up the housings of its manufacturing plant. These will be replaced by buildings of modern and fireproof construction that will cause the Company to be the possessor of a plant "at once homogenous and compact." So prints the Ansonia *Chronicle*, of recent date.

MR. E. L. SAWYER writes under date of September 22d: "Sawtelle, Cal., will likely be able to cook its Thanksgiving turkeys this year with gas. However, the Southern California Edison Company has commenced to lay mains thereto, and therethrough, and an active canvass for consumers is underway. It will cost $20,000 to hook up the Sawtelle district with the parent Company's trunk lines.

MR. CHARLES MELHUISH, formerly on the staff of the Williamsport (Pa.) Gas Company, has accepted a position on the staff of Manager C. H. Tippy, of the Dallas (Tex.) Company.

MR. F. S. FOGG has severed his business relations with the Granville (N. Y.) Gas and Electric Company, in order to accept an important position on the staff of the Wilde-Ramsay Company, of Glens Falls, N. Y. We are sorry to learn that Mr. Fogg has gone from the artificial lighting industry; but, whatever his future business relations may be, we wish him good luck in plenty.

"THE second fall meeting for 1911 by the members of the Wilmington (Del.) Gas Study Club, was held in the premises, 902 Washington street, some evenings ago. The proceedings were quite informal, but the matters discussed in rather haphazard fashion were sufficiently interesting to take up a spirited series of debates that lasted fully 1½ hours. The best thing about it all, though, was a plethora of evidence that each was glad to hobnob with the other fellow, after the vacation time was at an end.—PAX."

THE voters of Calmar, Ia., will vote on Thursday next over the question as to whether it would be advisable to bond the city for the purpose of raising the necessary funds for the construction of a gas plant, to be operated on municipal account.

RECENT advices from the Pacific Coast are to the effect that General Superintendent P. C. Funk and President John de Sabla, of the Pacific Gas and Electric Company recently visited Livermore, Cal., with a view to planing the erection of a plant of sufficient size to guarantee a gas supply to the settlements of Livermore and Pleasanton.

UNDER the acceptance of the proposition of the New Haven (Conn.) Gas Light Company the latter will establish and maintain 9 gas arcs, of high power, on Orange street, between Chapel and Crown streets, with a view to showing how simple, effective and cheap it is to light thoroughfares with gas.

## The Market for Gas Securities.

The gas share market showed some recovery for the week; but the recovery was so slight that one may be forgiven for fearing that the patient (meaning the general market) is still close to the relapsing point. However, for this relief we may be thankful. Consolidated opened to-day (Friday) at 133 to 135. A notable feature in all this recent spell of flaccidity in the specialties, especially in respect of gas shares, is that "values" have been smashed on very small volumes of sales.

If any symptom counts, this would point to the fact that small short lines have been put out, many of which remain uncovered. When the time comes for deliveries, if our thought is true, gas shares should recover as much in a day as they lost in weeks. The inquiry on bond account continues.

## Gas Stocks.

**Quotations by George W. Close, Broker and Dealer in Gas Stocks.**

**115 BROADWAY, NEW YORK CITY.**

OCTOBER 2.

☞ All communications will receive particular attention.

☞ The following quotations are based on the par value of $100 per share:

| *N. Y. City Companies.* | *Capital.* | *Par.* | *Bid.* | *Asked* |
|---|---|---|---|---|
| Consolidated Gas Co. | $78,177,000 | 100 | 134 | 135 |
| Central Union Gas Co.— | | | | |
| 1st 5's, due 1972, J. & J. | 3,000,000 | 1,000 | 103 | 105 |
| Equitable Gas Light Co.— | | | | |
| Con. 5's, due 1932, M. & S. | 1,000,000 | 1,000 | 115 | 118 |
| Mutual Gas Co. | 3,500,000 | 100 | 155 | 165 |
| New Amsterdam Gas Co.— | | | | |
| 1st Con. 5's, due 1948, J. & J. | 11,000,000 | 1,000 | 100 | 101½ |
| New York & Richmond Gas Co. (Staten Island) | 1,500,000 | 100 | 35 | 50 |
| 1st Mtg. Gold Bds. 5 p. ct. | 1,000,000 | — | 98¼ | 100½ |
| New York and East River— | | | | |
| 1st 5's, due 1944, J. & J. | 3,500,000 | 1,000 | 103 | 105 |
| Con. 5's, due 1945, J. & J. | 1,500,000 | — | 95 | 100 |
| Northern Union— | | | | |
| 1st 5's, due 1927, J. & J. | 1,250,000 | 1,000 | 94 | 100 |
| Standard | 5,000,000 | 100 | 50 | 70 |
| Preferred | 5,000,000 | 100 | 70 | 100 |
| 1st Mtg. 5's, due 1930, M. & N. | 1,500,000 | 1,000 | 103 | 105 |
| The Brooklyn Union | 15,000,000 | 1,000 | 130 | 133 |
| 1st Con. 5's, due 1948, M. & N. | 15,000,000 | — | 106¾ | 107 |
| Yonkers | 299,650 | 509 | 130 | — |
| *Out-of-Town Companies.* | | | | |
| Bay State | 50,000,000 | 50 | ⅝ | ⅛ |
| " Income Bonds | 2,000,000 | 1,000 | — | 75 |
| Binghampton Gas Works | 450,000 | 100 | — | — |
| " 1st Mtg. 5's | 500,000 | 1,000 | 95 | 100 |
| Boston United Gas Co.— | | | | |
| 1st Series S. F. Trust | 7,000,000 | 1,000 | 82 | 85 |
| 2d " " " | 3,000,000 | 1,000 | 47½ | 50 |
| Buffalo City Gas Co. | 5,500,000 | 100 | 5 | 8 |
| Bonds, 5's | 5,250,000 | 1,000 | 50 | 60 |
| Capital, Sacramento | 500,000 | 50 | — | 35 |
| Bonds (6's) | 150,000 | 1,000 | — | — |
| Chicago Gas Co. Guaranteed Gold Bonds | 7,860,000 | 1,000 | 104 | 106¼ |
| Cincinnati Gas and Electric Co. | 29,500,000 | 100 | 92 | 93 |
| Columbus (O.) Gas Co., 1st Mortgage Bonds | 1,500,000 | 1,000 | 96 | 98 |
| Columbus (O.) Gas Lt. & Heating Co. | 1,682,750 | 100 | 90¼ | 91 |
| Preferred | 3,036,500 | 100 | 75¼ | 80 |
| Consumers, Toronto | 2,000,000 | 50 | 200 | 204 |
| Consolidated, Baltimore | 13,460,084 | — | | — |
| Mortgages, 5's | 3,400,000 | — | | — |
| General Mortgage 4½ | 10,661,000 | — | | — |
| Con. Gas Co., Baltimore City, 4½ | 2,751,000 | — | | — |
| Consolidated Gas Co. of N. J. | 1,000,000 | 100 | 15 | — |
| Con. Mtg. 5's | 976,000 | 1,000 | 92 | 95 |
| Bonds | 75,000 | — | — | 100 |
| Denver Gas and Electric | 3,500,000 | — | 102 | 105 |
| Detroit City Gas Co. | 6,580,000 | — | — | 50 |
| " Prior Lien 5's | 5,619,000 | 1,000 | 97 | 100½ |
| Detroit Gas Co., 5's | 881,000 | 1,000 | 75 | 80 |
| Equitable Gas & Fuel Co., Chicago, Bonds | 2,000,000 | 1,000 | — | 101 |
| Essex and Hudson Gas Co. | 6,500,000 | — | 39 | 40 |
| Fort Wayne | 2,000,000 | — | — | — |
| " Bonds | 2,000,000 | — | 55 | — |
| Grand Rapids Gas Light Co., 1st Mtg. 5's | 1,350,000 | 1,000 | 100 | 101 |
| Hartford | 750,000 | 25 | 190 | 200 |
| Hudson County Gas Co., of New Jersey | 10,500,000 | — | 112 | 113½ |
| " Bonds, 5's | 10,500,000 | — | 103 | 103½ |
| Indianapolis | 2,000,000 | — | 78 | 83 |
| " Bonds, 5's | 2,650,000 | — | 104½ | 105 |
| Jackson Gas Co. | 250,000 | 50 | 93 | — |
| " 1st Mtg. 5's | 200,000 | 1,000 | 97 | 100 |
| Kansas City Gas Light Co., of Missouri | 5,000,000 | 100 | — | 86 |
| Bonds, 1st 5's | 3,822,000 | 1,000 | 102 | 104 |
| Laclede Gas Co., St. Louis. | 10,000,000 | 100 | 102 | 102½ |
| Preferred | 2,500,000 | 100 | 114 | 120 |
| Bonds | 10,000,000 | 1,000 | 102½ | 103 |
| Lafayette Gas Co., Ind. | 1,000,000 | 100 | — | 60 |
| Bonds | 1,000,000 | 1,000 | 60 | 65 |
| Louisville | 2,570,000 | 50 | 143 | 145 |
| Madison Gas and Electric Co. | | | | |
| " 1st Mtg. 6's | 400,000 | 1,000 | 106 | 106¾ |
| Massachusetts Gas Companies, of Boston | 25,000,000 | 100 | 87¾ | 88 |
| Preferred | 25,000,000 | 100 | 96 | 93½ |
| Montreal Gas Co., Canada | 3,000,000 | 100 | 218 | 218¾ |
| Nashville Gas Light Co. | 1,000,000 | 100 | 110 | — |
| Newark, N. J., Con. Gas Co. | 6,000,000 | — | 56 | 58 |
| Bonds, 6's | 6,000,000 | — | 137 | 138 |
| New Haven Gas Co. | 2,000,000 | 25 | 200 | — |
| Peoples Gas Lt. & Coke Co., Chicago | 25,000,000 | 100 | 103 | 103½ |
| 1st Mortgage | 20,100,000 | 1,000 | — | — |
| 2d " | 2,500,000 | 1,000 | 104 | — |
| Rochester Gas & Electric Co. | 2,150,000 | 50 | 88 | — |
| Preferred | 2,150,000 | 50 | 118 | — |
| Consolidated 5's | 2,000,000 | — | 104¼ | 105½ |
| San Francisco Gas Co., Cal. | 15,500,000 | — | — | — |
| St. Joseph Gas Co.— | | | | |
| 1st Mtg. 5's | 1,000,000 | 1,000 | 100 | 102 |
| St. Paul Gas Light Co. | 2,500,000 | 100 | — | — |
| 1st Mortgages, 6's | 650,000 | 1,000 | 104 | 106 |
| Extension, 6's | 600,000 | 1,000 | 112½ | 115 |
| General Mortgage, 5's | 3,447,000 | 1,000 | 97 | 98 |
| Syracuse Gas Co., N. Y. | 1,975,000 | 100 | 50 | 55 |
| Bonds | 2,047,000 | 1,000 | 101 | 103 |
| Washington (D. C.) Gas Co. | 1,600,000 | 200 | 445 | 450 |
| 1st Mortgage, 6's | 600,000 | — | — | — |
| Western Gas Co., Milwaukee | 4,000,000 | — | — | — |
| Wilmington (Del.) Gas Co. | 600,000 | 50 | 361 | — |

# MEETING TIMES OF THE VARIOUS GAS ASSOCIATIONS.

*American Gas Institute.*—Annual meeting, October 18, 19, 20, 21, 1911. St. Louis, Mo. Officers: President, Donald McDonald, Louisville, Ky. Secretary, A. B. Beadle, 29 West 39th st., N. Y. City.

*Canadian Gas Association.*—Annual meeting, ———— Officers: President, Arthur Hewitt, Toronto, Ont.; Secretary and Treasurer, John Keillor, Hamilton, Ont.

*Empire State Gas and Electric Association.*—Annual meeting, Oct 6, 1911. New York City. Officers: President, M. J. Brayton, Utica, N. Y.; Secretary, C. H. B. Chapin, 29 W. 39th street. New York City.

*Guild of Gas Managers of New England.*—Annual meeting, March, 1912. Young's Hotel, Boston; monthly meeting, second Saturday. Officers: President, Walter G. Africa, Manchester, N. H.; Secretary, H. K. Morrison, Brockton, Mass.

*Illinois Gas Association.*—Annual meeting, time, March, 1912, Chicago, Ills. Officers: President, C. B. Strohn, Elgin, Ills.; Secretary-Treasurer, F. E. Newberry, Dixon, Ills.

*Illuminating Engineering Society.*—Annual meeting, Sept. ————1912, ———— Meetings of Sections, monthly. Pres't, A. E. Kennelly, Boston, Mass.; Secretary, Preston S. Millar, 29 W. 39th street, N. Y. City. Sections: New York, Secretary, Albert J. Marshall, 36 West 39th street. New England, Secretary, W. S. Farrow, 1290 Massachusetts avenue, Cambridge, Mass. Philadelphia, Secretary, S. B. Eichengreen, Broad and Arch streets. Chicago, Secretary, F. H. Bernhard, Marquette Building.

*Indiana Gas Association.*—Annual meeting, Jan. 17 and 18, 1912, Indianapolis. Officers: President, S. E. Mulholland, Fort Wayne; Vice-President, Howard L. Olds, Indianapolis; Secretary-Treasurer, Philmer Eves, Indianapolis.

*Iowa District Gas Association.*—Annual meeting, time, May, ——, 1912; Clinton, Ia. Officers: President, G. W. Clabaugh, Omaha, Neb.; Secretary and Treasurer, G. I. Vincent, Des Moines, Ia.

*Kansas Gas, Water and Electric Light Association.*—Annual meeting, time, ———— Wichita, Kas. Officers: President, W. A. Scothorn, Hutchinson, Kas.; Secretary and Treasurer, J. D. Nicholson, Newton, Kas.

*Michigan Gas Association.*—Annual meeting, time, Sept. ————1912———— Officers: President, F. W. Blowers, Kalamazoo, Mich.; Secretary-Treasurer, Glenn R Chamberlain, Grand Rapids, Mich.

*Missouri Electric Light, Gas, Water Works and Street Railway Association.*—Annual meeting, April, 1912; St. Louis, Mo. Officers: President, F. E. Murray, Louisiana, Mo.; Secretary and Treasurer, N. J. Cunningham, Springfield, Mo.

*National Commercial Gas Association.*—Annual meeting, October 23-28, 1911. Denver, Officers: President, C. N. Stannard, Denver; Secretary, Louis Stotz, 29 West 39th street, New York City.

*Natural Gas Association.*—Annual meeting, May, 1912, Kansas City, Mo.; Officers: President, A. B. Macbeth, Independence, Kas. Secretary, T. C. Jones, Delaware, O.

*New England Gas Association.*—Annual meeting, third Wednesday in February, 1912; Boston. Officers: President, J. A. Coffin, Gloucester, Mass.; Secretary-Treasurer, N. W. Gifford, East Boston, Mass.

*New Jersey State Gas Association.*—President, William H. Pettes, Newark, N. J.; Secretary-Treasurer, Arthur H. Osborn, Belmar, N. J.

*Ohio Gas Association.*—Annual meeting, February 6 and 7, 1912, Columbus, O.; President, John M. Garard, Columbus, O.; Secretary-Treasurer, T. C. Jones, Delaware, O.

*Pacific Coast Gas Association.*—Annual meeting, Sept. ————1912, ———— Officers: President, F. A. Leach, Jr., Oakland, Cal.; Vice President, W. Baurhyte, Los Angeles, Cal.; Secretary-Treasurer, John A. Britton, 445 Sutter street, San Francisco, Cal.

*Pennsylvania Gas Association.*—Annual meeting, April, 1912, Williamsport, Pa. Officers, President, C. W. Butterworth, Millon, Pa; Secretary-Treasurer, William H. Merritt, Lebanon, Pa.

*Society of Gas Lighting.*—Annual meeting, December, 1911; monthly meeting, second Thursday. Place, New York City. Officers: President, Fred. S. Benson; Secretary, George G. Ramsdell, 254 West 39th street, New York city.

*Southern Gas Association.*—Annual meeting, April, 1912, Jacksonville, Fla. Officers, President, H. B. Hoyt, Jacksonville, Fla.; Secretary-Treasurer, E. D. Brewer, Atlanta, Ga.

*Southwestern Electrical and Gas Association.*—Annual meeting. April 27, 28, 29, 1912; Houston, Tex. Officers: President, J. E. Carroll, Beaumont, Tex.; Secretary, D. G. Fisher, Dallas, Tex.

*Wisconsin Gas Association.*—Annual meeting, May 15 and 16, 1912, Milwaukee, Wis. Officers: President, H. M. Buck, Waukesha, Wis.; Secretary-Treasurer, Henry Harmon, Milwaukee, Wis.